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THE Journal of GENERAL EDUCATION

VOLUME VI JULY 1952 NUMBER 4

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The University of Chicago Press

The Journal of GENERAL EDUCATION

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Published October, January, April, and July. SUBSCRIPTION PRICE: $4.00 *per volume. Single copies:* $1.25. *Checks should be made payable to The University of Chicago Press, 5750 Ellis Avenue, Chicago 37, Illinois.* EDITORIAL CORRESPONDENCE: *address the Editor,* THE JOURNAL OF GENERAL EDUCATION, *State University of New York, Albany 1, New York. Subscribers are requested to notify the Press and their local postmaster immediately of change of address.*

Entered as second-class matter at the post office at Chicago, Illinois. Acceptance for mailing at special rate of postage provided for in United States Postal Act of October 3, 1917, Section 1103, amended February 28, 1925, authorized June 9, 1950.

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EDITORIAL COMMENT

F. C. Ward

ATTEMPTS to improve the "articulation" between precollege and college studies have tended to founder not only upon the rocks of organizational separateness and differences in purpose and constituency but also upon overlapping and differences in emphasis in the realization of similar educational ends. As a result, students who now come to college from many high schools tend to be underprepared for intellectual work and overprepared for "life." Complaints of underpreparation voiced by college faculties center upon inadequacies in what might be called the "grammar" of collegiate studies—reading, writing, reckoning, factual geography and history, languages, and so forth. To this complaint, the answer is given by schoolmen that the schools are no longer to be regarded as primarily precollegiate academies. The schools have new purposes of their own, chief among these being the social functions of educating young Americans for citizenship and for various vocations, and students preparing for college are a minority of the school population to whose interests the citizenship and vocational training of the majority of the school population should not be sacrificed.

Valid as this view of the task of the schools may be, its acceptance has tended to dilute the basic grammatical training of the minority who do go on to college and to introduce a great deal of duplication into their preparation for "life." Given the present increased emphasis by the colleges upon general education as a preparation for adult life, it is clear that students whose grammatical training was diluted in school in favor of citizenship training are doomed to make up the former in college and partially to repeat the latter, unless a better articulation between precollege and college curriculums can be worked out. The experience of several colleges and universities which have for some years admitted students who have not finished the last year or two years of high school suggests strongly that, when such a student has acquired a basic set of grammatical skills and a certain amount of information, he may undertake college studies profitably and that some part (quite possibly the equivalent of two years) of the work which he is required to do in elementary and secondary school is not a part of his preparation for college work. The current shortage of skilled manpower, the length of many professional curriculums, the growing cost of education at all levels, and the demands upon young men for military service all add practical urgency to the theoretical case for improving the

Mr. Ward, Professor of Philosophy and Dean of the College of the University of Chicago, has titled his comment "Twice Prepared for Life and Half Prepared for College: An Amateur's Suggestion to Pre-Collegiate Educators."

articulation of precollege and college studies.

In this situation, how can the needs of the colleges and the autonomous ends of the high schools be reconciled in such a way that all students may move through their formal schooling into life in our democracy with a minimum of wasted time and a maximum of essential preparation both for democratic life and for professional and specialized academic work? My suggestion to precollegiate educators is that they consider seriously the possibility that reflective education for citizenship and vocational training could be concentrated in the last two years of high school and that the first ten years of schooling could be devoted to the development of basic grammatical skills and the imparting of factual knowledge needed by everyone whether or not he goes to college. Such a horizontal division between a basic grammatical curriculum and a terminal vocational and citizenship curriculum would permit the schools and the colleges to come to terms without sacrifice of the proper ends of either and to the substantial advantage of the individual student and of our society. When these two curriculums are pursued concurrently throughout elementary and secondary school, the grammatical disciplines tend to be diluted and overridden by the "larger ends" of citizenship and vocational training, and the student who goes on to college gets a second "general education" which might better have been his first. I should hope, also, that a horizontal order would enable elementary- and secondary-school educators to take full advantage of the psychological readiness of younger students to acquire basic skills and to soak up information in the grammatical curriculum and that the opportunity to plan and teach the terminal curriculum to students in their last years of schooling, possessed of basic skills and knowledge and expecting soon to enter American extra-school life, would be attractive to high school faculties.

If the grammatical curriculum normally occupied the first ten years of schooling, all students would be in all or most of it, and it might therefore not be necessary to place a special label upon those students who were to go on to college. (I am assuming that enrichment of courses and sectioning for superior students, whether precollege or not, would continue to be employed in schools which considered such existing practices desirable.) Competent students who were mature enough to do so would enter college upon completion of the grammatical curriculum. If lack of maturity or economic circumstances made postponement of college advisable, these students could continue their academic work in high school to a higher level and could properly expect the colleges to take account of their higher achievement through the use of "placement" procedures leading to "advanced standing." Competent students who were not going on to college would enter the terminal citizenship and vocational curriculum. Students who before their tenth year of schooling gave evidence of incapacity to complete the higher portions of the grammatical curriculum could be exempted from those portions and placed in appropriate sections of the terminal curriculum. Competent students who completed the grammatical curriculum on schedule and were not going on to college would be prepared for adult life in the terminal curriculum during their last two years of schooling.

Two minor categories of students would remain: those who entered college after the tenth or eleventh grade and left college soon thereafter and those who entered or completed the terminal high-school curriculum and then decided to enter college. Those members of the former group who wished to re-enter college would return to high school to make up such deficiencies in the basic disciplines as may have caused them to be dropped from college, while those who did not plan to re-enter college would enter the terminal curriculum. Those who

decided belatedly to enter college would experience some of the duplication which, it was argued above, is the fate of most students who go to college now, the exact amount of wasted time depending upon the quality of their high school's terminal curriculum and the receptivity of the college of their choice to the use of placement procedures and the granting of advanced standing.

In summary, the horizontal division between a basic ten-year curriculum for all students regardless of intention to go to college and a terminal curriculum in preparation for adult life designed primarily for those who will not attend college seems to me to offer a means whereby planners of elementary, secondary, and collegiate curriculums could take account of the common educational needs of young Americans and, at the same time, reduce substantially their present differences as to the manner in which students of various abilities, degrees of maturity, and academic intentions should be treated. The colleges could be expected to prepare their freshmen and sophomores for individual and collective life in our democracy on the basis of well-established common skills and knowledge developed in the basic school curriculum, and the high schools could develop autonomous terminal programs for students who will enter adult American life upon completion of their secondary education.

In proposing this rearrangement of curriculums and this altered manner of handling various categories of students, I have so far resisted the temptation to try to specify the exact content of the grammatical and terminal curriculums. Obviously, in the former case I have in mind such basic competences as reading a page of French or English with precise understanding, knowing where Malaya is or when the Republican party was founded, understanding a statistical statement, expressing one's thought in clear prose, grasping the structure of a work of art, understanding organic and physical processes, and so forth. In the citizenship curriculum, I assume that more reflective, interpretative, and problematic work would be carried on, presumably of the sort more intensively pursued in various current programs of general education in American colleges. The student's critical appreciation and understanding of himself, of his society, of the arts and sciences, and of religion, morals, and politics would be developed in the terminal curriculum in a form and to a degree appropriate to the capacities of the terminal students involved.

These details are supplied only in the interests of clarity, and not because I should be inclined to defend them (especially those suggested for the terminal curriculum, which is none of the colleges' business) against experts in elementary and secondary education. Further discussion of them would be useful only if my major proposal concerning the order of grammatical and citizenship training is of any interest or promise. The vital importance to the nation of improved articulation between the schools and the colleges emboldens me to place this proposal before readers of this journal and to invite comment from others who have encountered the problems with which it attempts to deal.

THE NATURE OF THE HUMANITIES

Arthur Berndtson

In contemporary society the natural sciences and the social sciences have made more apparent progress and have enlisted more support than have the humanities. Skill in handling means has grown more rapidly than wisdom in discerning ends; nations resort increasingly to violence and dishonor in the conduct of their internal and foreign affairs; and individual lives are beset with frustration and anxiety. These dislocations and evils are well known, and it is not the purpose of this paper to deal with them in substantive detail. It is, however, a major purpose of higher education to be concerned with these matters and to make serious proposals for dealing with them. Since education is in part a prisoner of its time and of the limitations of human nature, immediate and large solutions cannot be expected, and it is not surprising that education should itself mirror some of the evils that it is designed to overcome.

But within its limits the educational process has some power of action, and the extent to which it will realize this potentiality depends upon the degree of understanding of the problem and of the means available for solution. It is recognized by many that a major means is the extended cultivation of what academics call the "humanities." But to make effective use of the humanities in the educational process and in the attack upon contemporary ills, clear understanding is needed of the nature and function of the humanities. In default of such understanding, the humanities will be used in piecemeal fashion toward partial ends, and joint action of the humanities and of the other elements of liberal education will yield to internecine rivalry.

The definition of the humanities is difficult for reasons which are partly historical and partly analytical. Of the former, it is evident that there is little tradition of careful and comprehensive discussion of the nature of the humanities. From early times it has been the custom of moralists, rhetoricians, literary critics, and classicists to make contributions to the theory of the humanities, which are noted in many cases for sympathetic insight and hortatory appeal but which are typically lacking in generality and in depth of analysis. Philosophers and speculative anthropologists have had itinerant concern with the topic, with a flowering exemplified especially by contemporary activity on the Continent; the results are pertinent to the present problem, but they have metaphysical motivations and premises which are surely narrower and perhaps more dogmatic than the motives and assumptions appropriate to a general theory of humanistic education. During the last quarter of a century the general education movement has developed extensively in the United States, and programs in the humanities have been developed in colleges and colleges of universities both deliberately and articulately. Sincere attempts have been made to understand the reasons for curricular changes, but the variety of types of program and the looseness of stated objectives suggest that action has outpaced understanding of basic theory in all but a few instances.

Analytical causes of difficulty in defining the humanities stem from considerations of method and of the inadequacy

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of certain methods that might be proposed for getting at the essence of the humanities. An extensional method would start with a decision as to the fields of activity comprising the humanities and would induce from the aggregate of the fields those characters which belong to all the humanities and to none of the other fields of liberal activity. Several objections have been made or may be made to this procedure. It is sometimes said that a given example of humanistic work may draw its materials and methods from several fields of liberal activity and that, of the several "modes of interpretation" appropriate to these materials and methods, only one is humanistic. This is indeed the case, but it has no force against an extensional method which takes care to eliminate characteristics distinctive of others of the liberal arts. It may further be objected that this method tends toward a simplified view of the humanities, which would allocate to them characteristics completely absent from other liberal activities, whereas it may well be nearer the truth to suggest that the humanities are concentrated and purer illustrations of characteristics appearing in less emphatic form in the various sciences. It seems that the extensional method can readily be modified to meet this objection. More cogently, it is evident that a decision as to the fields comprising the humanities is controversial and that a final decision as to their identity should be nearer the end than the beginning of the process of definition. The fields commonly regarded as belonging to the humanities are the fine arts (including literature), philosophy, and history. It may reasonably be argued that religion should not be omitted from such a grouping. It will be said by some historians that their discipline is a social science, or an aspirant thereto, rather than one of the humanities; this question is of first importance in the organization of general courses in the humanities. And philosophy has a variety of problems and interests, which overflow into the natural and social sciences and into a region anterior to the three major fields of liberal activity. The common identification of the humanities thus suffers from a good deal of heterogeneity, which suggests a basis in administrative convenience rather than in community of nature and purpose.

Reversing the direction of the extensional method, an intensional method would start with a dominant conception of what it is to be humanistic; deduce from this concept, or add to it from without, such other characteristics as may be helpful in distinguishing the humanistic from the scientific and the liberal; and identify the humanities as those fields of activity which illustrate the chosen concept. Undoubtedly this method has the advantage of refinement in the analysis and ordering of concepts. But difficulties appear in the multiplicity of conceptions, reflecting the local fashions of times and of doctrines, and in the extremes of generality or specificity found in standard conceptions. Undoubtedly the humanistic concerns man and those things which are human, but without further aid this concept gives no reason for excluding the biological and social aspects of man, which are not usually regarded as of direct concern to the humanist. The term "humanism" has more content, but its varied interpretations include matters as diverse as Protagorean relativism, a return to the standards of classical antiquity, the denial of supernaturalism, and a cultivation of poise and moderation. Clearly these subconceptions suffer from narrowness in comparison with the field of the humanities, from schism among themselves, and from doctrinaire qualities from which a philosophy of education must free itself if it is to achieve general application.

In default of a third method, it appears that the wisest procedure is to use an extensional method, which gives promise of greater flexibility and completeness without sacrifice of control. To avoid dogmatism and unnecessary controversy,

the extension of the humanities may initially be taken at a reasonable minimum, to which virtually all parties will agree, although some may wish to make additions in the course of the examination. This minimum must not only pass the social test of common assent but must have range of content and influence without undue loss of homogeneity and must be felt as responsive to what is prevailingly, although loosely, regarded as the specifically human concern of the humanities. From this minimum field may be derived a maximum set of common characteristics, which may be accepted as the primary formula for the humanities. It will then be in order to consider the claims of other fields to be included in the humanities and, beyond that, the relation of the humanities to the sciences and to the liberal arts in general.

We may take as our starting point the field of the fine arts, including literature. The first characteristic that may be induced generally from the fine arts is that of values: in their most central and unambiguous form, the humanities are concerned with values. This is evident in a song of unreflecting love and in a critical essay advising a civilization on how to survive. But virtually all human activities have a relation to values, since they are motivated; and thus the concept of value applies generically to all the liberal arts. It is nevertheless true that values have a dominant position in the humanities and only a subordinate position in the natural and social sciences. This distinction, which affords a differentia for the humanities, can be developed through a number of contrasts involving the form and the content of values.

In regard to form or method, values in the humanities differ in several ways from values in the sciences. (1) In the humanities, values are inherent in all phases of the field, while in the physical sciences they are limited to secondary and relatively extra-mural phases. Like any science, physics may be described in terms of (*a*) a body of propositions about the objects studied; (*b*) methods, including propositions about methods and about propositions of the preceding phase; and (*c*) relations of the preceding phases to human beings and their purposes. Values do not appear in the first of these phases. In the second phase, logical or intellectual values appear, as in the use of the term "truth" and in the statement that a given proposition is better than another, whether as a description of data or more commonly as an explanation of propositions describing data. Truth is the primary value discussed in this phase, and the predicate "better" is used in a relation subordinate to truth; but the value-status of truth is not discussed but is deferred to the third phase, where it is appropriate to consider the value-status of all the attendants and consequences of the science. (2) In the sciences of living things, values may enter the first phase, but consideration of these values is limited to "descriptive" methods, while in the humanities values are treated both descriptively and normatively. An anthropologist may describe the religious practices and values of a group of people, but he passes beyond the scientific aspect of his inquiry if he attempts to erect a system of norms about the holy, whether generally or in relation to the group in question. The humanities imply no such restriction. (3) In the humanities, procedure has a further practical aspect, which may be hortatory or expressive or both; but there is no parallel in the sciences. Thus a poet may express an emotion or attempt to arouse an attitude; but a psychologist describing these matters attempts to do neither.

Beyond these differences of a formal kind, and undoubtedly more striking, are differences of content. Whatever values may be pertinent to the several sciences may enter into the content of the humanities; in addition, the humanities may deal with values which either fall beyond the province of interest of the sciences or beyond their capacity. Of the sciences, psychology and sociology appear to come

closest to the humanities in range of values dealt with; it would appear that any human interest or experience might have some relevance to these sciences; but the latter are limited to conceptual and verbal methods and must therefore abstract from those differentiations of values which can be gotten only through particulars and through such media as sound and color.

Since there is no experience or judgment of value which may not concern the humanities, it is not to the present purpose to catalogue the major types of values to be found in the humanities: it may be sufficient to say that the values in question are summarized in experience as a whole and in the agent and distillate of experience, human personality. The person embodies the entire value-orientation of the humanities and may thus be considered the focal point of the first criterion of the humanities. But it has such weight in the scheme of values and in discussions of the humanities that it may be singled out from its context and proposed as a second major character of the humanities. To this proposal there can hardly be any objection. Humanists as diverse as Socrates, Montaigne, Pope, and Aldous Huxley agree that human experience and human personality are the materials and goals of humanistic activity. But there will be disagreement as to the description of the person and as to the importance for the humanities of one description or another.

Among certain writers of an idealistic persuasion it is held that the properly humanistic enterprise celebrates a view of man as distinct from nature and more or less independent of it. According to this view, as it may be stated in composite form, man is spirit, which is endowed with freedom, with ability to reflect upon itself, and with creative valuation. Since the sciences do not readily substantiate such a view of man, the humanities are considered as endowed with privileged modes of knowing, with which it is possible to arrive at evidence of the view in question. In direct opposition to this view is another, which assimilates man to nature, and nature to the supposed realm of inert particles, and which holds that man is merely an effect, whose power of self-reflection is inefficacious and perhaps illusory and whose valuations are derivative and perhaps irrelevant. And between these extreme positions are others, of various shadings.

The problems and positions involved in the foregoing doctrines are interesting and important; they are also controversial to the point of confessing their present insolubility. Fortunately for the definition and practice of the humanities, a decision among them is not required. This follows from the limited nature of the present problem. A theory of the humanities is not a theory of man or of what men have said about man, although the theory of the humanities must be broad enough to provide for a subject matter in which such matters are discussed. Neither is a theory of the humanities a theory of the processes of learning and instruction, for which a basis may well be found in a psychology which, in turn, implies a certain metaphysic. In distinction from these concerns, a theory of the humanities is an account of what human activities may be included in this field and of the reasons for including them. And this relatively nondoctrinal view finds ready support from the history of the humanities as developed in the fine arts. A poet may be a skeptic or a devout believer, an idealist or a materialist, a determinist or a libertarian, an empiricist or a mystic, without prejudice to his status as a poet and as a part of the subject matter of the humanities.

Although a theory of the humanities must abstract from such limiting doctrines in its approach to human nature, it is not without materials for the description of a humanist's interest in human personality, which may be found in common experience and without benefit of world hypotheses. Accounts of this interest may vary, since they come most fit-

tingly from humanists rather than from scientists; but the following suggestions may be made in regard to the typical or predominant spirit of the humanities when confronted with human nature.

1. The humanities suggest an organic view of the ideal of human nature. In seeking to understand, express, and shape human personality, the humanities are interested in man become conscious of himself and seeking through that consciousness to fulfil himself. For the humanist, fulfilment implies the exercise in organic unity of the various powers of human nature. Men have the power to feel and to think, and the humanist is interested in the complete development of these powers. Feeling needs to be diversified, ordered, and expressed: to realize these ends, thinking is essential. In itself, thinking may become instrumental, technical, and mechanical; to be purged of these limitations, thinking needs to be intimately informed with feeling without being subverted by it. By these methods of organic interplay, the area of meaning and appreciation in human experience is indefinitely extended: and this is the principal business of the humanities.

2. The humanities suggest an ideal of inwardness modified by objectivity. Although the natural and social sciences tend to emphasize the world external to the individual, the humanities are concerned with the subjective reaction of the individual to the world. This concern runs in the same direction as the humanistic development of sensibility through the fine arts. But lest this deepening of the inward resources of the person entail moral solipsism and other forms of vanity and error, the humanities balance inwardness with objectification in the various media of expression, as will be shown in greater detail below.

3. A further interplay in the humanities can be found between the notions of individuality and sympathy. The humanities emphasize the individual person as distinct from groups, although not necessarily in opposition to groups; the individual is regarded as unique, irreplaceable, and ultimate in value; and the array of individuals of all sorts testifies to the inexhaustible diversity of human nature. Since some of these traits suggest atomicity, a balancing tendency can be found in the experience of sympathy. Without the characters of individuality and sympathy, the humanities would readily fall prey to the provincial moralist.

4. The humanities also have an interest in genius and its characteristic of creative power. Greatness of soul and other forms of nobility are not limited to genius, but they are most articulate there. Genius is not limited to the humanities, since creative power appears in the sciences and elsewhere, but for various reasons genius is nearer the center of attention in the humanities than in other activities. In no merely edifying sense, the study of greatness in man may be a major contribution of the humanities to education.

The foregoing traits may be taken as suggestions of what the humanities find of significance in human personality, and thus of substance in the field of values. Perhaps it will be granted that they are generally important in the humanities. But it may be argued that the personality they qualify is not limited to the humanities and cannot be used as a defining feature of the humanities. It may be said that every science implies a relation to persons as agents of science; that the social sciences deal with persons in groups; and that psychology and kindred social sciences deal with persons as individuals. In all these cases, however, the relation of the science to personality is as qualified as it was earlier claimed to be in relation to values; and this similarity of relation follows readily enough from the fact that human personality is not distinct from the field of values, but a summary of it. It appears, then, that human personality has sufficient predominance in the humanities to furnish a criterion for them.

Human personality and the values that it discovers or creates in ordinary experience are the materials of the humanities, but they do not suffice for a complete life or for the entire definition of what is distinctive of the humanities. The desideratum in both contexts is aesthetic form, which is undoubtedly the most striking feature of the fine arts. Form in the fine arts consists of a medium, whether verbal, visual, or auditory, whose elements are given an artificial and skilful order. The function of aesthetic form is to objectify and express human experience and human personality, clarifying and purifying the emotional basis of experience as it is made incarnate in form. The result is the most complex form of self-expression available to us, and on its behalf extreme claims may reasonably be made; for, through expression, the individual increases understanding and appreciation of what is within him, becomes less acquisitive and competitive in regard to external things, communicates more readily with others, and achieves liberation in a positive mode.

Aesthetic form is the most distinctive character of the humanities and the goal of humanistic activity, much as systematic understanding is the major trait and end of the sciences. The raw materials of the humanities, found among values of ordinary experience and personality, do not constitute the humanities in the full sense until they are taken up into form. Human actions, such as being in love or failing in business or dying for humanity, do not enter into the humanities until they are experienced or represented as having form, as in a poem or in a novel. Even materials of relatively great elaboration and intelligibility, such as an idea of focal importance in a world view, do not wholly belong to the humanities until they enter into the determinate forms of determinate works of art. Thus what distinguishes a poet as poet is not the social philosophy that he may advocate or the religious experience that may guide him but the forms that he may create for the embodiment of the philosophy or the experience.

Although form is the central character of the humanities, it is not limited to them but occurs wherever intelligence discerns or imparts structure to experience or symbols. Form is therefore essential to the sciences, and a ready example may be had in the apprehension of a system of ideas or marks in mathematics. The system may be said to objectify the intellect, which is fulfilled in the act of understanding the system. The system may also objectify desire, such as the desires to understand, to find harmony, and to achieve mastery. The objectification of intellect illustrates nonaesthetic form, which is not the special concern of the humanities, and the objectification of desire illustrates aesthetic form, which has been assigned to the humanities. Aesthetic form may therefore be found among the sciences, but it is not a major motive of the sciences, nor is it highly elaborated among them. Predominance of aesthetic form is therefore available as a distinguishing mark of the humanities.

In the trio of aesthetic form, human personality, and values, we have a closely related set of characters induced from a relatively homogeneous and extensive group of activities, the fine arts. These traits answer, in the more precise and articulate form here given them, to the prevailing sense of the meaning of the humanities. It is now possible to propose a definition of the term "humanistic." An activity may be said to be completely humanistic if it involves maximum use of aesthetic form, human personality, and values; and it may be called partially humanistic if it involves less than all three of these traits or significantly diminished intensities of them. The humanities may then be defined as those fields of activity which are completely and dominantly humanistic. With these definitions in mind, the questions then arise whether the humanities extend beyond the fine arts and what may be the relations of the

humanities to the sciences and to liberal education generally.

With the fine arts disposed of, the remaining candidates for admission to the humanities are history, philosophy, and religion. In its broadest sense, as the record of all particulars, history belongs in no special field of liberal learning but furnishes materials for all of them. In its typical sense, as the record of all human particulars or of those particulars which are especially social in nature, history belongs partly to the social sciences and partly to the humanities. History is humanistic when it makes a normative or critical account of personality and values, but it cannot as a science deal as freely and extensively with values as do the humanities. History is not dominated by concern for aesthetic form, although some historical writing is not deficient in this respect. In its essence, history has that interest in the concrete and individual which the humanities have by virtue of their concern for aesthetic form and for the individual personality. Summing up these aspects, it may be said that history is neither completely nor dominantly humanistic and thus cannot be counted among the primary group of the humanities. But by virtue of its relatively generous use of humanistic traits, history may be reckoned among what may be called the "secondary humanities." And this reluctance to exclude history from the humanities finds support in what might be considered a humanist's sense of the import of history. If the purpose of the humanities is to make the individual fully conscious of the meaning and value of human experience, of its problems, powers, and defeats, there is no better means than the synoptic study of what great individuals and leading civilizations have done and suffered in the pursuit of the same consciousness. And this thesis can be given a specific application in the relation of history to the major achievement of the humanities, tragic art; for tragic art gains in meaning if painful circumstance and tragic art are viewed as universal and necessary parts of history and if history itself is taken as the parent-document of tragedy.

Like history, philosophy has a range which extends through all the liberal arts. As method, philosophy claims to underlie, to inspect, and to evaluate the procedures and habits of the sciences and humanities alike; here philosophy may be assigned to none of the liberal arts, but to a region logically anterior to them. As a body of problems and principles having a subject matter taken from experience or from supposed reality, philosophy enters into the basic and speculative parts of all fields of the liberal arts. Like the sciences, philosophy pursues systematic understanding and abstract generality rather than aesthetic form and concrete generality. Like the humanities, philosophy deals freely and ambitiously with values and with human nature. In between the two, philosophy attempts to do justice both to the world of objects and to the needs and temper of the philosophizing human being. If it fails in the former, it can take consolation in what it achieves in the latter. For the history of philosophy is a record of individuals and of works which have dealt seriously and luminously with the problem of the meaning and value of the world and of man and have achieved determinate forms which not only objectify the intellect in its greatest range but also express human desire for understanding, power, and peace. Here philosophy has a strongly humanistic bearing, which indicates that it cannot be omitted from participation in the field of the humanities; like history, it may be placed in the secondary humanities.

The situation of religion in relation to the humanities is complex for reasons other than those found in the instances of history and philosophy. Religion is a heterogeneous activity, which strays outside the liberal arts in its institutional aspect, overlaps philosophy in theology and ethics, and uses several of the fine arts in its rituals and devotions. Its con-

cern for human nature and for values is extensive and free, but it does not as a whole involve aesthetic form. In these respects it is strongly but not completely humanistic, with no nonhumanistic concern competing for dominance. But it may be held that, by virtue of its typical doctrines, religion is ruled out from the character of the humanities. Thus religion may be regarded as denying or derogating from the human when it advocates such doctrines as those of the supreme value of a nonhuman deity, the inherent evil of man, and asceticism. Undoubtedly such doctrines contradict dogmatic humanism in its various forms. But these interpretations of humanism are not criteria of the humanities and cannot be cited as reasons for barring religion from the humanities. And it should be evident that if a religion voices a poor opinion of human nature, it does so not with the intention of ignoring or destroying man but with the hope of reshaping human nature and of perfecting it. The appeal to a divine nature as standard or ideal is not usually made for the sake of deity, which is commonly regarded as already complete, but for the sake of man. The doctrine of transcendence in many religions is thus as compatible with the humanities as is a theory of immanence, and it may well be that transcendence accords better with the basic intention of liberal education. Religion may therefore be granted a place in the humanities, of a modified kind similar to that of philosophy and history.

With provision made for the fine arts, religion, philosophy, and history, the list of the members of the humanities is reasonably complete, for humanistic characters elsewhere are not sufficiently intense and dominant to justify further inclusions among the humanities. It follows that general education in the humanities must have a direct concern for the fine arts as reflections or instances of values, human personality and asthetic form, and direct or indirect concern for the secondary humanities, which may be studied under their own titles or as subject matters, motives, and methods appearing within the fine arts. Humanistic education must also consider the role of humanistic traits in the sciences and the relations of the humanities to the sciences and to liberal education generally.

The humanistic characters of the sciences are many and can be appreciated by the scientist without harm to the dominant concern of the sciences. Various traits have already been noted. Man and valuation are the agents of the sciences, and human powers of observation, imagination, and reason underlie the sciences. The world studied by the sciences is partly nonhuman, and some would call it monstrously so; but the conceptual, propositional, and hierarchical form of the sciences is quite human, and it may delight sensibility as well as inform the intellect. And the sciences may have large effects upon human nature, apart from their applications; they may foster tolerance, disinterestedness, respect for the rational powers of man, and the kind of sympathy implicit in the act of knowing. Human nature does not consent to much improvement in these matters, but the sciences are relevant means, and both the humanist and the scientist must welcome them.

All the sciences participate in these humanistic matters by virtue of their motives and methods, but the social sciences have a further likeness to the humanities by virtue of their subject matter. This raises questions as to the precise boundaries of the two fields, which have already been touched upon in passing. The social sciences ostensibly deal with the characters of groups and of individuals as members or patients of groups; but there is need for a science dealing with every aspect of human nature, and the social sciences are qualified to fill this need because of their proximity and the absence of any competitor. It might be said that the humanities are a competitor. But the humanities do not claim to be sciences; and their function in the un-

derstanding of man is not to be alternatives to the social sciences, but complements. For a creature as complex and elusive as man, various modes of study are both appropriate and necessary. The social sciences may be expected to prosecute the study of human nature according to their modified versions of scientific method and thereby to produce a considerable body of empirical materials and closely associated theory. Philosophy will further the systematic study of man, operating on levels which are more speculative because of normative methods and increased generality; it will avail itself of whatever experiential materials may be available and relevant, whether from the social sciences or from common observation. And the fine arts may provide both illustration and original documentation, ranging from naturalistic observation to myth: materials lacking in system but in some cases closer to experience than protocol statements, with an advantage of vividness due to aesthetic form.

It is implicit in this discussion of the relation of the humanities to the social sciences that the humanities do not have an autonomous and uniform method of knowing and that they do not as a group take knowledge as a major concern. The humanities take experience seriously, but they have no experiential materials other than those available from common experience or from scientific investigation. In dealing with these, the humanities make varying uses of the sharpened powers of observation of a novelist, the introspective delicacy of a poet, the analytic habits of a philosopher, or the power of sympathetic projection common to many artists. These skills make experience richer and more meaningful than is commonly the case, but they are lacking in checks and standards. There is no organized intersubjective scrutiny and evaluation, as among scientists, but at best an appeal over the years to the consensus of a school or tradition, which is certain to have enemies. But the skills and habits in question, when coupled with a broad base of experience and wide learning, terminate ideally in a kind of critical wisdom which is neither common sense nor science and is more suited than either of these to the problems and purposes of the humanities. Beyond this sort of wisdom the humanities do not go, despite the beliefs of those who claim to find in the humanities privileged functions of a mystical or visionary kind. An artist may be a mystic, but his mysticism is distinct from his art and raises questions of validity which are not settled by merely humanistic methods. A poet may be said to have a vision of the nature and destiny of man; but, if the vision has any merit, it will be found to have sources in the critical wisdom noted above, mixed with passional elements which are more nearly a fiat from the poet's sensibility and will than statements of cognitive relevance.

These restrictions on the cognitive function of the humanities will find rather ready acceptance in our time, which is relatively naturalistic and positivistic; but there is danger of a pendulum movement to the other extreme, at which it would be held that the humanities should be taken over by scientific method and converted into sciences. Many humanists have felt that the humanities lately have suffered from this excessive scientism, and cause for their alarm is not purely sectarian but may be found in the very limited relevance of scientific method in the humanities. In a broad sense of the term, where scientific method is a combination of experience, reason, and willingness to modify beliefs, the method is of basic value in the humanities as elsewhere and is incorporated in varying degrees in the critical wisdom which is the ideal type of humanistic knowing. But in the narrower and more exact sense appropriate to the most rigorous of the natural sciences and responsible for the current prestige of the term, "scientific method" does not do justice to the problems and purposes of the humanities but tends toward their

elimination or emasculation. In this rigorous sense, scientific method includes three sorts of components: a requirement of publicly and precisely testable observation, which therefore implies sense-perception and experiment; quantitative statement; and attitudes of disinterestedness, suspension of judgment, tentativeness, and willingness to submit in one degree or another to the consensus of informed experts. It is no derogation from the high value of this method to say that it is not a universal panacea. The humanities touch on levels of human personality and experience which can be reached only through introspection; and, rather than pool introspections by statistical enumerations from the population at large, they rely on the introspections of exceptional persons. The humanities deal with the qualitative aspects of experience, which for some purposes are too varied for conceptual handling and which are not subject to quantification except in loose and intensive terms. And the humanities are especially concerned with values in the fullest sense of that concern; but the seat of valuation is partly inward and private, final values are not subject to rational determination, and the imperatives of feeling and action do not coincide with scientific disinterestedness and tentativeness. It follows, then, that although the subject matter of man should be studied scientifically as far as possible, as in the case of the social sciences and their degrees of modification of scientific method, there are areas of understanding of man which elude even the most flexible methods of those sciences; and these areas belong to the humanities.

A *modus vivendi* for the sciences and humanities is to be found not by the imposition of the one upon the other but by a recognition of the diversity of problems, purposes, and methods; by careful distinction of variations within a given method; and by catholicity in the study of marginal areas, where varying purposes and methods may overlap in fruitful interplay. If these requirements are met, the humanities and the sciences will more readily be recognized as partners in liberal education and as sharing in its nature. It is true that the aims of liberal education are stated in discourse which belongs to the humanities and that the aims are realized in the humanistic realms of values and personality; but the means for the enactment of these ends belong to both the sciences and the humanities, and the ends may appear in the persons of both humanists and scientists.

The ends of liberal education may be stated in various ways. In the general and abstract mode appropriate to a philosophical theory of the humanities, the ends of liberal education may be said to include organicity, contemplative interest, freedom, generality, form, and transcendence. Organicity implies the reciprocal meaningfulness of elements of experience, or their maximum interaction; most generally, it means that intellect and emotion, knowing and feeling, have important contributions to make to each other, without subversion of the integrity of knowing or of the intensity of feeling. This organic process is a good in itself and the container of all other goods; it is therefore an object of contemplative interest, which does not deny the possible relevance to the experience of other types of interest. Since the experience is of value in itself, it is not constrained by external factors and is in that sense free. Further aspects of self-determination and freedom appear in the fusion of native principles of power or vitality on the one hand, and order and structure on the other: the experiencing sponsored by liberal education is based on a kind of "vital reason." But the fusion and its elements depend on generality, for power and order are not native and intrinsic principles in a limited context but require the universal as their theater. Given structure of any kind, there is form; and given structure with generality, there is form with complete freedom. This form

is real and not abstract, for it expresses the vitality contained within it. And since the experience has achieved form and generality, the self to which it belongs has resolved its characteristic turbulence and schism and has transcended its usual limits by participation in a universal good.

These are the aims of liberal education, and they are not less valuable for being difficult and rare in their consummation. They are also the aims of human life and the custom of a divine life if there is one. But they are not esoteric, despite their metaphysical formulation, for they fit into the pattern of living as naturally as being in love or walking in a garden or playing with a child. For these reasons, liberal education takes precedence over other forms of education and does not defer to variations of disposition or ability. For liberal education, like the aims it serves, is a universal good and not the privilege or the need of a few.

LANGUAGE AND LANGUAGES IN THE LIBERAL CURRICULUM

Hugh M. Davidson

THE consequences of the aims sought by those who are now engaged in defining and executing plans of general education have not been seen or felt equally in all sectors of the undergraduate enterprise. This fact is scarcely surprising, if one considers the divergent and ambiguous (often unavoidably so) statements of principles which have issued from the working centers of the "movement," or if one considers something even more basic: the intricate and at the same time panoramic character of the undertaking itself. Nevertheless, the consequences of the sometimes dimly perceived principles must be faced, even by those of us who teach foreign languages. While no one will claim that the redefinition of subject matters which is occurring in the areas of the natural sciences, the social sciences, and the humanities is near completion, one can assert that the discussion there is well advanced. Some important alternatives are in sight. That much cannot be said for the area—or sector, if you will; we have become accustomed to something less than the *beau rôle*—of undergraduate language study. It is the purpose of this brief essay to set down certain reflections reached within the bounds of these current perspectives.

In a program of studies regulated by the demands of a specialty, where the student is addressed as one who is to pursue the ends of a particular investigative or practical order, the study of a foreign language tends to be strictly practical; it is learned so that one may get at technical journals, firsthand information, original sources. It is an instrument, and time spent on it goes for paradigms and recipes. There is usually no serious attempt to understand it, even as an instrument. It is not nearly so clear what foreign-language study should be under the new dispensation, where the student is seen primarily as a being destined to seek a decent *total* existence. But in a curriculum which claims a degree of completeness, which has its special charity for all fields of knowledge and action, which does not simply make use of languages, they cannot be taken for granted. As I see it, one cannot avoid in a coherent liberal curriculum some effort to achieve an inclusive and yet made-to-measure treatment of the whole topic, of language itself as well as of foreign languages. This distinctive obligation appears to divide at once into two, since language may be dealt with in two ways, as a subject matter and as an instrument, as a that-which and as a that-by-means-of-which. One further division of the latter term, and foreign-language study comes into view as the discipline which introduces the student to the use of a language other than his own, in contrast to that which increases mastery of his native language. Let us examine some of the pedagogical alternatives which seem to follow if the first of these distinctions is granted and the accompanying obligation accepted.

Suppose, then, that the problem is the teaching of language as a subject matter to nonspecialists. We may decide to emphasize the fact that language is something *known*. In that case we shall find

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ourselves returning often to the assertion that linguistic scholars have by their exertions brought into being a repertory of valid observations and conclusions about their subject matter. Sometimes—and one must say "often," in popular expositions—this view tends to a vulgar species of positivism for which the study of language and languages began in the nineteenth century with the "reconstruction" of Indo-European or in the twentieth century with the investigation of exotic tongues. It is, however, perfectly compatible with a position so generous as to set aside no intelligent speculation about language, whatever the location or time of the speculator. The act of choice of the curriculum-maker is exercised, in any event, on a body of attested knowledge; he draws out, as from a library, the items required by the special conditions of his plan.

Another possible point of departure is the conception of language as something *knowable.* Here the emphasis lies not on what has been settled but rather on the potentialities of the subject matter, on its perennial ability to generate new inquiries, each to some degree satisfactory "in its own terms." Such a position is at times reached by those whose attention is attracted particularly to the mass of conflicting statements which have been made about language. A higher-grade version of this position is held by those who, through an analysis of the process of inquiry itself, discover the means whereby the diversities may be elucidated or occasionally resolved. In any case, the curriculum-maker has to do with a repertory of theories or "constructs" dealing with an ever green subject matter. What he hopes to do justice to is the variety of approaches rather than the variety of conclusions.

There is a strong element of caricature in those extreme views of language. But they do suggest pure positions which could be developed more fully, both as positions and as answers, more or less adequate, to a curricular problem. Even on the basis of the present sketchy treatment, some things may be said about advantages and disadvantages. One must recognize as a weakness, if one considers what will be left in the mind of the student, the tendency of training by the first of these views to short-circuit understanding, to treat superficially, if at all, the necessities which underlie the truths taught. There is likely to be missing the precious ability to διδόναι λόγον of which Plato speaks. The opposite weakness into which the opposite position may fall results from its tendency to produce a special, quasi-mathematical kind of understanding. Here the temptation is to lose sight of the physical reality which in some way regulates the discourse from without. Or, to vary the figure, the student's attention may be fixed not on the persistent themes but, instead, on the variations produced by this or that analytical clavier.

Where the problem is posed in this way, it is clear that the solution requires finding some proper and acceptable compromise between the two positions. The task is obviously easier to conceive and delimit than to carry out, although it seems not impossible. There are, indeed, truths which the student can be asked to retain about the ubiquitous phenomenon of language—I shall try to point out some of them later—but he must be allowed to see what guarantees these *memoranda.* The presentation must be such that conclusions are known as consequences deriving from operations in which some problematic aspect of language is recognized, a way of attacking it chosen, and investigative activity performed. And, in my opinion, that is still not enough. Some sense of the tentative (I do not say hypothetical) character of linguistic investigation remains to be supplied. The best way to impart this seems to me to be the examination of more than one substantial and contrasting paper on each major topic. Perhaps then the student will see linguistic science as a sort of organism developing now by invention,

by some new departure touching the subject matter or the way of handling it, now by extension, by further exploitation of inquiries and techniques already available.

If it is granted that something like the discipline just defined belongs in the liberal curriculum, the place where it should be put must be decided. It can be presented independently, but I believe it should be taught in close association with the particular foreign languages. The study of language as a subject matter is essentially comparative in its methods and conclusions; it is not about *a* language but about *language*. Consequently, it seems unlikely that such study can really get off the ground if it confines its attention to English, the native language of the students. From the first lesson to the last, the work of a language class requires in one way or another the juxtaposition of English and some other tongue. The linguistic elements entering into this critical process cover the entire range from single sounds to whole works, or beyond that, to whole languages. In no other place in the curriculum is speech in its varied forms and uses likely to receive such sustained attention; nowhere else is there likely to be so favorable a climate for the growth of a modest degree of sophistication in such matters. Both the work on language in general and that on the foreign language stand to benefit by being associated. The former might gain in concreteness and depth, and the latter might, as its dividend, take on an added measure of intellectuality.

Let me try to be less abstract. What would this symbiosis look like in detail? In a reading course and in the intermediate stage of such a course, as students go into the transition period between graded and ungraded reading, there is a place for a review of certain troublesome grammatical topics, such as pronoun and verb systems and the syntax of longer and more complicated sentences. Since this is a review and not an initial presentation, it should not be hard to lead the discussion into theoretical paths. In fact, a salutary sort of autocriticism can occur. A case can be made for the streamlining of grammatical training in the earliest phase of a reading course, the aim being to furnish the indispensable notions and to get on at once with vocabulary building and practice in reading. The extremely practical character of this grammatical baggage is an encouragement for the teacher to allow himself a good many oracular and legislative statements in class. *Oportet haereses esse.* This second treatment of grammar might well be the occasion for reexamining rules, finding premises, and looking at alternative analyses. A selection from Hermann Paul, for instance, could give the whole set of traditional grammatical categories a shaking-up, using examples taken from the very languages to which they are supposed to apply. An extract from Franz Boas could show how some of the traditional categories need to be subdivided differently if they are to be used in interpreting non-Indo-European phenomena. A piece from the *Hermes* of James Harris might exemplify the attempt to fix a new set of classes, universal in application, a linguistic net which will catch any kind of fish. (In fact, I believe that an interesting and by no means ill-spent hour can be filled by parsing a text or analyzing tenses in Harris' terms.) To get some understanding of any one of these positions, and especially of all of them, and then to look back at what one had been saying all along could hardly fail to produce an experience appropriate to undergraduate language study.

At a later stage in the course, when the work turns on fixing and refining the ability to read by the explication in class of various texts and by extensive reading outside class, topics in "semantics" can be introduced without being far-fetched. For example, in going over carefully a page written in a foreign language, a student can see how the words of his native

language divide up his ideas and sort out things in one way, but not in the only way. Devotion to friends, patriotism, and reverence toward the divine seem quite distinct as words and as ideas in English; in classical Latin they may be united under one term, *pietas*. The word λόγος in the New Testament imposes on a broad semantic area a kind of unity which disappears when the Latin of the Vulgate maps the same territory by means of at least three words, *sermo, verbum,* and *ratio*. A further fragmentation occurs in English, which needs at least four words for the three of Latin: *speech, word, reason,* and *proportion*. This is the sort of point which comes up constantly in language classes. Why should it not be treated explicitly in connection with, let us say, the *Cratylus* or *The Meaning of Meaning*? Related to it is the problem of the degrees of exactness which are possible in translation. It is clear that the feasibility of restating precisely in a second set of words what was originally said in another set varies according to the type of discourse—one division of which might be scientific, poetic, and practical—and translation exercises designed according to this view might put students on the trail of fundamental shifts in the functions of linguistic symbols as those boundaries were crossed.

Although as here conceived the teaching of language "in general" and that of a foreign language in particular are complementary parts of a single task, it is certain that the proper aim of the foreign-language course includes much more than furnishing illustrations for the theoretical statements of linguistic science. Actual working with the foreign language as an instrument is what is sought primarily. Here, again, reference must be made to curricular principles. It is only with them in mind that one can choose among linguistic capacities and the uses to which they may be put.

As is evident from the partial description just given, the foreign-language course which seems to me to make most sense in a liberal curriculum is one which concentrates on reading and interpreting texts, with only subordinate emphasis on acquiring facility in oral and written expression. The reasons for this choice could be stated in various ways and at various lengths. One way the case might run, in brief, would be this: writing and speaking a foreign language are accomplishments which demand more time, if they are to be more than the basis of a classroom game, than the returns can justify in a liberal program of studies. To spend all or most of one's time learning to express one's self in French or German or Spanish is to concentrate less on coming to have something to say and more on those to whom one intends to say it. It is a method which widens one's audience, presumably to include native speakers of the language; it facilitates travel; it may further military, diplomatic, and commercial careers. In other words, it prepares one primarily—though obviously not exclusively—for a vocational or professional specialty. The practicality of the end dictates the typical means: drills and more drills. With its recorders, amplifiers, and headsets, it tends to distract attention from the artistic and scientific values of language study just as excesses of grammatical analysis did in pre-ASTP, pre-electronic days. Moreover, unless the investment in time is great, the capacity for expression which results is likely, when used, to oversimplify and caricature one's thought as soon as the dialogues of address-seeking, room-renting, and meal-ordering are over. It seems better from the point of view of method and results to have the student spend most of his time (it will not be more than two years anyway) on reading, an activity which ushers him with relatively little delay into a realm that is new and enlightening without forcing him over hurdles which are really part of specialized training.

But it is not my intention here to describe a course in detail or to dwell on ways and means of learning the foreign language. Instead, I wish to address my-

self to the problem of defining the kind of use of the reading capacity, however acquired, which seems consonant with liberal aims. The first principle which I should like to advance is that time spent in interpretation and discussion must go for first-rate, unaltered texts as soon as possible. They may have to be short at first: a page of Plato or Horace, of Voltaire or Unamuno. No one, neither the teacher nor the student, can become really interested in graded texts. They are, I think, necessary crutches, but they exist only to be discarded. Everywhere else in the liberal curriculum the student is likely to be trying himself on substantial works; for us to keep him on a diet of anecdotes and fairy tales for one moment beyond the necessary minimum is a serious mistake.

A second and related observation also bears on the character of the texts. Many of them should be relevant to the current academic interests of the students. This suggestion is less restrictive than it may at first appear. Often it entails not so much a new collection of readings as a new way of dealing with the old. Suppose that in the French course the student is set to work on Pascal's fragment about the "*disproportion de l'homme.*" Should he not confront this view of humanity as poised between two infinites, lacking certain knowledge of the principle or end of things, with what he has learned in his biology course about men as participants in an ecological and evolutionary competition, or with what he has read in philosophy, where rational animals may have been put at the top or near the top of some metaphysical hierarchy, or with what he thinks he knows about men as social beings aspiring to independence and autonomy and yet, inevitably, creatures of the city? It is plain that no elementary language course can dispense with grammatical and syntactical drills. It is no less plain that excessive preoccupation with those things will keep the student from seeing in the foreign text anything more than a cryptogram, i.e., something to be unscrambled and put into other words. That decoding exercise done, he can go on to the next assignment without ever allowing what the text said to set his mind in motion or granting the foreign author an occasion to enter into converse with others being read elsewhere in English. This means, incidentally, that we shall need to find out in more than a casual way what our colleagues are teaching.

The liberal curriculum invariably includes courses in which "great" books or portions of "great" books are read in translation. When students are able to engage in exercises of the type I have just described, that linguistic capacity ought to be set to work on these books outside the language class (or inside, whichever seems more feasible). Why cannot the explication and discussion of translations be supplemented by references to original texts? Do translations always suffice "for our purposes" in undergraduate teaching? Occasions do arise and not infrequently, I suspect, when reference to the author's words in his own language would be helpful. It would be rash to say that such an exercise is indispensable or necessarily illuminating. Originals can be just as opaque as translations. Whatever the answer we give to the second of those questions, the answer to the first seems evident: there can be no harm in asking and helping students to avail themselves, wherever possible, of their linguistic training in interpreting the works they study. And that experience will make it possible for them to understand exactly the act of faith they commit whenever they open their stout books of selected readings to passages translated from languages they do not know.

It is well to be precise and realistic about the hermeneutic problems with which such undergraduates may be expected to deal. Their activities will certainly not be comparable to those of the expert who can bring to bear on a work an extensive fund of philological learning about its setting and the peculiarities of its language. With proper guidance, however, they can be expected to make the

sort of point which is evident from an attentive juxtaposition of the original and the translation. Here is an example of what I mean. In a class in criticism, I remember that there was, in our discussions of Taine's introduction to his *History of English Literature,* some mystification over the word "epoch" which had been used as the translation of the third member of the famous triad: *race, milieu,* and *moment.* The ambiguity of *moment* in French serves Taine well. The word indicates clearly an analogy from a positive science; it effectively renders the notion of a critical point in a developing sequence. By careful examination of the context surrounding "epoch" one can recover approximately the initial meaning of the term. But if the French text is at hand, it takes no great linguistic ability to grasp both the meaning and the connotation of the original. Or, again, take the case of πράττειν in the *Poetics* of Aristotle. It is the center of an important group of words having the same root: πραττῶν, πράξις, and πράγμα. The kinship of these words is obvious in Greek; a rather misleading dispersion occurs in English when they are translated, respectively, as "to do," "man in action," "action," and "incident." To say, for example, that a plot is an "arrangement of incidents" strikes me as a less luminous formula than to say it is a σύστασις πραγματῶν, where the word suggests at once the cardinal idea of action and the connection with other terms in Aristotle's technical vocabulary. It would not be hard to provide more elaborate examples involving sentences or groups of sentences instead of isolated words. But the point is, I think, already clear: there is a useful sort of *grammatical* study of words and sentences in the original which students can undertake as a parallel to the *analytical* resolution of texts into terms, principles, and conclusions.

Closely supervised reading and discussion in class of intellectually respectable materials and interpretative exercises on works or parts of works read in translation elsewhere appear, therefore, to be essential activities in a liberal foreign-language course. To those ingredients I should wish to add one more: reading chosen entirely by the student, begun as soon as possible, and done concurrently with the other assignments. By the practice of these three activities there can be built up a habit of independent exercise of a proficiency related to the current needs and interests of the student. Two points require emphasis. The exercise must eventually be independent, or very nearly so; and it must be directed to a variety of texts for pleasure and profit. Without these two characteristics one may have something very like the usual product of our language courses, but one may doubt whether it is something which is intelligible and defensible in a program of general education.

An important question remains, the answer to which is prior to everything I have said about the teaching of a foreign language as an instrument. The assumption has been, throughout, that practice in the *use* of a foreign language followed from the conditions of curriculum-making taken as the point of departure. It is one thing to agree that language treated as a subject matter (including, though in a speculative way, its instrumental dimension) belongs there; it is quite another to go on to advocate learning and using with reasonable facility a particular foreign language. What is the justification for its place? I doubt that an answer satisfactory to everybody can be given at the present time; certainly, it cannot in a few words. Part of one answer has been given already. Texts and discussions dealing with the general problems of language tend to the arid and abstract without constant reference to particulars and especially to comparative data of the kind which is continually at hand in the language course. Furthermore, the usual dependence on translations can at least be recognized by all and occasionally alleviated through the exercise of the reading ability here defined and defended. Finally, an important contribution of the foreign-language course to

general education, a contribution which it can make with unique effectiveness, lies in what it can do to eliminate or to mitigate provinciality. The undergraduate should begin to appreciate outlooks other than his own; he should begin to see resemblances and make distinctions in the face of what is foreign. There are other courses which apply themselves to the production of this virtue; it is for the foreign-language course of the sort described here to add a final touch, to reveal to the student via language the *other* in its very *otherness*. The act of understanding a foreign text, which may or may not coincide with the act of translating it, requires the balancing of viewpoints and even of patterns of existence in a lived intuition. Two realms are brought together, the foreign and the familiar, at times widely different, at times almost perfectly tangent. This peculiar act of seeing likes and unlikes is at the heart of the liberating power of foreign-language study. From it flow many an aesthetic and philosophical conclusion. It does not happen every day in classrooms; beyond a certain point the inevitable drill work precludes it; but it can and does occur with great vividness apropos of a poem or a prose text of genuine merit.

Language presents itself to us, then, under two principal aspects, as an object of investigation and as an instrument (that term being limited, for present purposes, to some foreign language). Neither of these, taken by itself, will suffice if language study is really to become a part of the liberal curriculum as it is evolving around us. The natural comprehensiveness of a plan of general education requires attention to both. My attempt has been to answer questions of *what* and *how much* for both aspects and to suggest a way of combining both in a single teaching venture. It has seemed proper to emphasize, with regard to linguistic discipline as such, representative principles and methods as well as conclusions, in order that there may be imparted a grasp of both the object and the inquiries directed to it. Beyond that kind of understanding lies the province of the researcher, whose immediate aim of extending knowledge distinguishes him from the student with whom we are concerned. A foreign language as an instrument presents a different problem. The question is not to decide on an appropriate mode of understanding; it is rather to consider the acquisition and suitable use of a tool. I have said little about the mechanical aspects of language-learning. It seemed more important to specify sorts of texts for reading in and out of class, and sorts of exercises, both guided and unguided. Here the line separating the undergraduate from the specialist must be drawn differently. It is like that which separates the amateur performer on the piano or violin from the concert artist, for the interpretative technique which we wish to communicate has a definable upper boundary.

These two elements can be integrated into a single sequence, where the topics inherent in the successive phases of language learning serve as points of departure for excursions into linguistic science. The theoretical component—that dealing with language as a subject matter—serves, as I see it, to introduce the student to something in itself worthy of the attention of any educated person, in itself a member of any liberal catalogue of knowables, and at the same time to something which pervades all study and discussion of other subject matters. The practical component—that having to do with the use of a foreign language—supplements the first by providing extensive and provocative facts to be understood in the ways proper to a general examination of language, advances the explication of works read in other parts of the curriculum, and, through its unique power of projecting the student into a mentality other than his own, adds another facet to that synoptic *prise de conscience* which is one of the most obvious aims of a liberal education.

MILL ON EDUCATION

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JOHN STUART MILL describes his *Autobiography* as a record of the "successive phases" of a mind "which was always pressing forward, equally ready to learn and to unlearn either from its own thoughts or from those of others."[1] The statement is remarkable for its mingling of pride and humility: Mill was proud of a lifelong effort to maintain an open mind, and he was humble in his acknowledgment of all that he owed to others. But the *Autobiography* is not the only record of the "successive phases" of his thought; the description could be applied to an edition of his collected works. It would be an obvious point of departure for a preface, and an occasion for remarking some odd consequences: for example, the notice taken of Mill in recent years by F. A. Hayek and the late Harold J. Laski, two of the most outspoken representatives of opposed schools of thought in Mill's special field of political economy. For Mill moved between the poles of antithetical traditions of which Bentham and Coleridge were, as he put it, "the two great seminal minds." The main shifts in his position have been neatly summarized by D. C. Somervell:

> Mill never ceased to be a leader of the Benthamites, but he led them a very long way from the point at which he found them. Trained as a sworn foe of aristocracy and privilege, he concludes with an eloquent warning against the tyranny of democracy; trained as an individualist, upholding *laissez-faire* and freedom of contract in all departments of economics, he makes, as years pass on, many concessions to the school of thought which promoted the Factory Acts and prepared the way for Socialism; trained as an advocate of the orthodox Benthamite hedonism, i.e., "pleasure" as the end of life, he transforms it into something not far removed from a philosophy of self-sacrifice; trained as a free thinker, he reaches at last a position which, though it is not dogmatic Christianity, is probably the position held by many who are prepared to call themselves Christians.[2]

The point is, of course, a familiar one to all who know Mill, but it merits repetition here, both as a reminder of the kind of difficulty one can meet in attempting to define Mill's idea of education and as a possible clue to the mode of resolving it.

Such an approach does not, however, preclude the possibility of an exception to the rule of transformation. From the past observations of competent authority one may indeed be tempted to suppose that education was one subject about which Mill changed his mind least, if he changed it at all. Alexander Bain, who knew Mill as both friend and fellow-worker, scrutinizes his claim to an open mind and concludes that, although he "stood very high on the point of receptiveness," he held rather stubbornly to some ideas, chief among them "the doctrine of the natural equality of men." On this subject, says Bain, "he

[1] *Autobiography of John Stuart Mill* (New York: Columbia University Press, 1924), p. 1. All subsequent references to this work, unless otherwise noted, are to this edition, "published for the first time without alterations or omissions from the original manuscript in the possession of Columbia University."

[2] *English Thought in the Nineteenth Century* (London, 1929), p. 94.

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was, in my opinion, blind to a whole region of facts. He inherited the mistake from his father, and could neither learn nor unlearn, in regard to it."[3] The corollary of the doctrine of natural equality is that environment, especially education, accounts for differences among men. Thus J. M. Robertson, accepting Bain's statement, accuses Mill of "habitually writing as if all differences in capacity were due to education."[4] And Wilfrid Ward, a critic of a very different persuasion from Bain and Robertson on other matters, agrees with them on this point:

> Mill had the educating mania. . . . From his father he had early learnt to think that if only people were thoroughly well educated and freed from the dead hand of outworn institutions all would be well with the world. And greatly though his views eventually changed, this early way of looking at things left its stamp on him through life.[5]

Specialists in education who compare the early chapters of the *Autobiography* and the *Inaugural Address* at St. Andrews with James Mill's article on education printed in the supplement to the fifth edition of the *Encyclopaedia Britannica* also stress the son's indebtedness to his father. "The profound effect which was produced upon the mind of John Stuart Mill by the education of his childhood and early boyhood is manifest in the St. Andrews *Inaugural Address*," says John William Adamson, who describes the *Address* as "dominated by his father's intellectualism" except for its "very real concern for aesthetic cultivation."[6] In all that has been said on the question heretofore, the prevailing view seems to be that the transformation of Mill's thought on other subjects had very little effect on his theory of education.

But this view will not survive a close examination of the evidence. Here, if anywhere in the discussion of Mill, it is appropriate to heed Professor Hayek's warning "not only against overstressing the influence of this early education on his later views but also against overestimating the length of the period during which he remained completely under the sway of the views he had been taught."[7] It is true that, on such questions as the natural equality of men, innate versus acquired characteristics, and the importance of education to the improvement of mankind, Mill maintained a large measure of predisposition in favor of the teachings of his father and Jeremy Bentham. But even James Mill was less doctrinaire on these matters than his critics allow. In his article on education, for example, he qualifies Helvetius' contention that "l'éducation nous fait ce que nous sommes": "This much, at any rate, is ascertained, that all the difference which exists, or can ever be made to exist, between one *class* of men and another, is wholly owing to education."[8] In the *Autobiography* John Stuart Mill implies a further modification of this view when he describes his *Examination of Sir William Hamilton's Philosophy* as an attack on

> the prevailing tendency to regard *all* the marked distinctions of human character as innate, and in the main indelible, and to ignore the irresistible proofs that by far the *greater* of those differences, whether between individuals, races, or sexes, are such as not only might but naturally would be produced by differences of circumstances.[9]

That some important differences are innate, especially those of most concern to the teacher, is admitted in the well-

[3] Alexander Bain, *John Stuart Mill* (New York, 1882), p. 146.

[4] *Modern Humanists* (London, 1891), p. 107.

[5] *Men and Matters* (London, 1914), p. 146.

[6] *English Education, 1789–1902* (Cambridge, 1930), pp. 305–6. See also *James and John Stuart Mill on Education*, ed. F. A. Cavenagh (Cambridge, 1931), pp. xxiii–xxiv. Mr. Cavenagh's edition contains James Mill's *Britannica* article as well as the St. Andrews *Inaugural*.

[7] Introductory essay to his edition of Mill, *The Spirit of the Age* (Chicago, 1942), p. viii.

[8] Cited by Cavenagh, *op. cit.*, p. viii. The italics are Mill's.

[9] *Autobiography*, p. 192. The italics have been added.

known statement about his own powers as a student, offered in proof of the assertion that his education showed how much the average child could be taught:

> If I had been by nature extremely quick of apprehension, or had possessed a very accurate and retentive memory, or were of a remarkably active and energetic character, the trial would not be conclusive; but in all these natural gifts I am rather below than above par.[10]

It is not, however, in the modifications of these general ideas that the main departures of John Stuart Mill from the earlier utilitarian views on education are to be found, but rather in his radical change of opinion regarding the limitations of popular education and the possibility of a higher education that would accomplish the same ends, though by means of an essentially different and much slower process. This change is especially evident in the essays written in the period following the crisis that caused a reaction against his youthful Benthamism and brought him under the influence of the Coleridgeans. It persists, with some refinements, in his later works and finally issues in the *Inaugural Address,* delivered by Mill on the occasion of his installation as Rector of St. Andrews University. At all points it reflects the general transformation of his thought.

During the second and third decades of the century, the utilitarians and their allies sponsored many projects whose central purpose was the dissemination of useful knowledge among the people. Their aim was not only to help the people raise their standard of living, but also to arouse their interest in political and social affairs, to encourage them to seek a larger voice in those affairs, and to prepare them for the time when, it was hoped, they would be enfranchised.[11] "It was my father's opinions," says Mill, "which gave the distinguishing character to the Benthamic or utilitarian propagandism of that time."[12] And the distinguishing character of his father's opinions was faith in the influence of reason and knowledge over the minds of men:

> So complete was my father's reliance on the influence of reason over the minds of mankind, whenever it is allowed to reach them, that he felt as if all would be gained if the whole population were taught to read, if all sorts of opinions were allowed to be addressed to them by word and in writing, and if by means of the suffrage they could nominate a legislature to give effect to the opinions they adopted.[13]

This conviction determined James Mill's idea of education and inspired his zeal for popular education. He wrote a pamphlet entitled *Schools for All.* He joined Lord Brougham, Francis Place, and others in founding the West London Lancasterian Association,[14] the purpose of which was to establish schools in London west of Temple Bar and north of the Thames. When this project failed, he worked with Bentham in an unsuccessful attempt to start a school, characteristically called by one of Bentham's neologisms "chrestomathic"—that is, "conducive to useful knowledge," as Bentham explained in *Chrestomathia,* a treatise in which he set forth the design of the institution. James Mill was also one of the prime movers in the founding of the University of London, and he served on the committee of Brougham's Society for the Diffusion of Useful Knowledge. His belief in the possibility of raising the intelligence of the working classes to an unprecedentedly high level is expressed in a typical passage

[10] *Ibid.,* p. 21.

[11] For an authoritative account of this movement, see Adamson, *op. cit.,* especially chap. i, "The People and the People's Education."

[12] *Autobiography,* p. 72.

[13] *Ibid.,* p. 74.

[14] So named after Joseph Lancaster (1778–1838), the rival of Andrew Bell (1753–1832) for the honor of having first introduced the method variously called "mutual," "monitorial," and "Madras," according to which pupils taught each other.

of his article on education, where he asserts that, although "there are degrees of intelligence which must be reserved to those who are not obliged to labor . . . a very high degree of intellectual acquirements" may be attained, and "a firm foundation may be laid for a life of mental action, a life of wisdom, and reflection, and ingenuity, even in those by whom the most ordinary labor will fall to be performed."[15]

In the days of his "youthful propagandism" John Stuart Mill embraced the faith of his father in a popular education based on the diffusion of knowledge and the influence of reason. He gives an interesting account of how his father's opinions "were seized on with youthful fanaticism by the little knot of young men" of whom he was one:

> What we principally thought of, was to alter people's opinions; to make them believe according to evidence, and know what was their real interest, which when they once knew, they would, we thought, by the instrument of opinion, enforce a regard to it upon one another. While fully recognizing the superior excellence of unselfish benevolence and love of justice, we did not expect the regeneration of mankind from any direct action on those sentiments, but from the effect of educated intellect, enlightening the selfish feelings.[16]

In a speech on "The Utility of Knowledge," before the Mutual Improvement Society in 1823, he proclaimed that "the only useful knowledge is that which teaches us how to seek what is good and avoid what is evil," but nevertheless devoted all his time to remarking the practical consequences of the "revival of science and the cessation of feudal darkness," the increase of wealth and the comforts and conveniences of life. He looked forward to a day when wealth would be "generally and equally diffused throughout the whole community" and leisure would "force" the working classes to seek society and education:

> Each working man becomes himself better qualified to distinguish right from wrong, while each knows that he is under the constant surveillance of hundreds and thousands equally instructed with himself. Thus does the improvement of the physical sciences, by increasing and diffusing wealth, indirectly tend to promote morality.[17]

He attacked those who "raise a cry against the diffusion of knowledge on the ground that it renders the people dissatisfied with their institutions." He spoke of a "democracy of intellect" that would eventually replace the "aristocracy of wealth and rank" and efface the "evils of feudal despotism and superstition." "Knowledge has done much, but it has not yet done all," he concluded.[18] And a few years later, in the same spirit, he addressed the London Debating Society on "Perfectibility":

> . . . by all just rules of induction we ought to conclude that an extremely high degree of moral and intellectual excellence may be made to prevail among mankind at large, since causes exist which have been confessedly proved adequate to produce it in many particular instances.[19]

He proposed that "such a system of education should exist as will give to the mass of mankind not learning but common-sense practical judgment in ordinary affairs."

The speech on "Perfectibility" seems to have been the last occasion for referring to education from his father's point of view. It was given in 1828, in the midst of the intellectual and emotional crisis during which he discovered, as D. C. Somervell has put it, that Benthamism was "not enough." The story has been told many times and need not be repeated here, save for a brief restatement of two very important effects of this crisis on his opinions:

[15] Cavenagh, *op. cit.*, pp. 62–63.

[16] *Autobiography*, p. 78.

[17] *Autobiography*, with an Appendix of hitherto unpublished speeches and a Preface by Harold Laski (Oxford, 1924), p. 270.

[18] *Ibid.*, p. 274.

[19] *Ibid.*, p. 291.

> In the first place, [the experiences of this period] led me to adopt a theory of life, very unlike that on which I had before acted, and having much in common with what at that time I certainly had never heard of, the anti-self-consciousness theory of Carlyle. I never, indeed, wavered in the conviction that happiness is the test of all rules of conduct, and the end of life. But I now thought that this end was only to be attained by not making it the direct end. . . . The other important change was that I, for the first time, gave its proper place, among the prime necessities of human well being, to the internal culture of the individual. I ceased to attach almost exclusive importance to the ordering of outward circumstances, and the training of the human being for speculation and action.[20]

Although he did not turn against intellectual discipline, he now thought that it had effects that required correction and that the ideal to be sought consisted in a balance between intellect and feeling: "The cultivation of the feelings became one of the cardinal points in my ethical and philosophical creed." He read Wordsworth, Coleridge, and Goethe and fell more and more into friendly relations with his "Coleridgean adversaries" in the London Debating Society, Frederick Maurice and John Sterling. In 1829 he began his study of the works of Comte and the St. Simonians, "the writers by whom, more than any others, a new mode of political thinking was brought home to me."[21] And in 1830 he met Harriet Taylor, whose influence supported the tendency of his new opinions.

The first effects of these opinions on his view of education are revealed in the articles entitled "The Spirit of the Age," written for the *Examiner* in 1831. In the first article Mill's thesis is that the present age is an age of transition: "Mankind have outgrown old institutions and old doctrines, and have not yet acquired new ones." In the second, he dwells on the consequences:

> In all other conditions of mankind, the uninstructed have faith in the instructed. In an age of transition, the divisions among the instructed nullify their authority, and the uninstructed lose their faith in them. The multitude are without a guide; and society is exposed to all the errors and dangers which are to be expected when persons who have never studied any branch of knowledge comprehensively and as a whole attempt to judge for themselves upon particular parts of it.[22]

What is the remedy? The one which Mill says "will probably occur to most persons as being the most simple and natural" is the diffusion of knowledge and the growth of intelligence among the people—in other words, the remedy proposed by the utilitarians. At this point he begins to make the pronouncements that show the great change in his views:

> A large portion of the talking and writing common in the present day, respecting the instruction of the people, and the diffusion of knowledge, appears to me to conceal, under loose and vague generalities, notions at bottom altogether fallacious and visionary.[23]

After a disclaimer to the effect that he still has great expectations of vast social improvements arising out of the growth of intelligence among the people, he writes:

> But I do not believe that, along with this intelligence, they will ever have sufficient opportunities of study and experience, to become themselves sufficiently conversant with all the inquiries which lead to the truths by which it is good that they should regulate their conduct, and to receive into their own minds the whole of the evidence from which those truths have been collected, and which is necessary for their establishment. If I thought all this indispensable, I should despair of human nature.[24]

What, then, is the alternative? Here Mill introduces the idea for which he was perhaps chiefly indebted to Comte but

[20] *Ibid.*, pp. 99–100.

[21] *Ibid.*, pp. 101, 107, 114.

[22] *The Spirit of the Age*, p. 17.

[23] *Ibid.*, p. 23.

[24] *Ibid.*, p. 24.

which he could also have found in Coleridge:

> Those persons whom the circumstances of society, and their own position in it, permit to dedicate themselves to the investigation and study of physical, moral, and social truths, as their peculiar calling, can alone be expected to make the evidences of such truths a subject of profound meditation, and to make themselves thorough masters of the philosophical grounds of those opinions of which it is desirable that all should be firmly *persuaded*, but which they alone can entirely and philosophically *know*.[25]

Only three years before, in his speech on "Perfectibility," he had proposed an education that would give the masses "not learning, but common-sense practical judgment in ordinary affairs." He had spoken confidently of enabling all men "to see that a thing is wrong when it is wrong . . . to despise humbug, see through casuistry and imposture." But now he writes:

> It is easy to say that the truth of certain propositions is obvious to *common sense*. It may be so: but how am I assured that the conclusions of common sense are confirmed by accurate knowledge? Judging by common sense is merely another phrase for judging by first appearances.[26]

Of course, every man should be encouraged to use his reason, but reason itself will teach him that he can finally trust only the authority of "still more cultivated minds" as the ultimate sanction of his own reason.

Professor Hayek has rightly remarked that these articles show Mill "almost at the height of his reaction against his earlier views."[27] The full extent of this reaction and its effect on his attitude to education are shown in the essays written during the decade that followed the appearance of "The Spirit of the Age," the best of which Mill collected and published as *Dissertations and Discussions* in 1859. In these essays he develops the idea of an aristocracy of "cultivated minds," suggests the conditions essential to the establishment of national institutions for the purpose of educating this aristocracy, and finally prescribes courses of study and methods of teaching. His ideas on these subjects are at every point consistent with his changing political opinions.

In "The Right and Wrong of State Interference with Corporation and Church Property," published in the *Jurist* in 1833, Mill begins on the old utilitarian note to the effect that "the primary and perennial sources of all social evil are ignorance and want of culture." But then he goes on to say that for their removal men have always depended and must continue to depend upon "the unremitting exertions of the more instructed and cultivated." He even recommends Coleridge's idea of a revival of the clergy as a lettered class:

> A national clerisy or clergy, as Mr. Coleridge conceives it, would be a grand institution for the education of the whole people: not their school education merely, though that would be included in the scheme; but for training and rearing them, by systematic culture continued throughout life, to the highest perfection of their mental and spiritual nature.[28]

A few years later, in an essay on Adam Sedgwick's *Discourse on the Studies of the University of Cambridge*, the end of popular education is simply "to educate common minds for the common business of life." But the function of the university is "to keep alive philosophy," to provide

> the education by which great minds are formed. To rear up minds with aspirations and faculties above the herd, capable of leading on their countrymen to greater achievements in virtue, intelligence, and social well-being; to do this, and likewise so to educate the leisured classes of the community generally, that they may participate

[25] *Ibid.*, p. 25.

[26] *Ibid.*, p. 28.

[27] *Ibid.*, p. viii.

[28] *Dissertations and Discussions* (2 vols.; London, 1859), I, 38.

as far as possible in the qualities of these superior spirits, and be prepared to appreciate them and follow in their steps.[29]

This drift toward an aristocratic conception of education was a reflection not only of his study of Comte and Coleridge but of convictions borne in upon him by the course of political affairs during the thirties. There is evidence of a growing anxiety in Mill over what seemed to him to be a failure somewhere in modern civilization to produce the type of exceptional man, the able individual, who was the glory of less enlightened ages. Commenting on a brief review by Mill of the parliamentary session of 1835, Alexander Bain remarks:

> It is of the tone and character of all his political writing in those years; a retrospect of recent achievements, with a view of the present position and declaration of the one thing needful for it—a leader. He bitterly complains of the absence of a man of action, and asks, "Why does not Mr. Grote exert himself? There is not a man in Parliament who *could* do so much, or who is more thoroughly the people's friend."[30]

These were the years of growing disillusionment over the results of the Reform Bill of 1832. In his tribute to John Austin, the one among his old friends whom Mill found most sympathetic to his new views, Mill remarks that Austin correctly predicted that the bill would not bring about the improvements expected by its supporters, and approves his reason: "The men, he said, who could do these great things, did not exist in the country."[31] All that Mill has to say of education in his essays of the thirties is inspired by the idea of a discipline that will produce great men able to do the great things that legislation and the diffusion of knowledge had failed to do.

No wonder, then, that the aim of education as set forth in the essay on "Civilization" in 1836 is no less than "the regeneration of individual character among our lettered and opulent classes" and that the means is a program of studies intended "to form great minds." Although he regards the systems of Oxford and Cambridge, Eton and Westminster, with "utter abhorrence," he scornfully rejects the counsel of those who would reform those institutions "by bringing their studies into a closer connection with what it is the fashion to term 'the business of the world,'" that is, by substituting modern languages and experimental science for logic and the classics:

> We would have classics and logic taught far more really and deeply than at present, and we would add to them other studies more alien than any which yet exist to the "business of the world," but more germane to the great business of every rational being—the strengthening and enlarging of his own intellect and character. The empirical knowledge which the world demands, which is the stock in trade of money-getting life, we would leave the world to provide for itself; content with infusing into the youth of our country a spirit, and training them to habits, which would ensure their acquiring such knowledge easily, and using it well.[32]

The uncompromisingly high standards to which this education must adhere are defended with a youthful defiance by a quotation from a novel attributed to Frederick Maurice, a strange authority to cite in the pages of the utilitarian *London and Westminster Review*:

> I know that nine-tenths of those whom the University sends out must be hewers of wood and drawers of water; but, if I train ten-tenths to be so, depend upon it the wood will be badly cut, the water will be spilt. Aim at something noble; make your system such that a great man will be formed by it, and there will be a manhood in your little men of which you do not dream.[33]

A major point of his program is that the purpose of all teaching should be not

[29] *Ibid.*, pp. 95–96.

[30] *Op. cit.*, p. 47.

[31] *Autobiography*, p. 125.

[32] *Dissertations and Discussions*, I, 193.

[33] *Ibid.*, pp. 194–95.

indoctrination but discipline in the methods of apprehending truth:

> The very cornerstone of an education intended to form great minds, must be the recognition of the principle, that the object is to call forth the greatest possible quantity of intellectual *power*, and to inspire the intensest *love of truth;* and this without a particle of regard to the results to which the exercise of that power may lead, even though it should conduct the pupil to opinions diametrically opposite to those of his teachers.[34]

Does this mean that the teacher must refrain from forcefully presenting his own opinions? Mill answers this question as many defenders of academic freedom answer it today. Of course, the teacher should present his own opinions as effectively as possible: "To abstain from this would be to nourish the worst intellectual habit of all, that of not finding, and not looking for, certainty in anything." But he is not to be held to a particular creed. The question should be not whether his opinions are "right" but "whether he is well instructed in those of other people, and, in enforcing his own, states the arguments for all conflicting opinions fairly." Mill's brief essay was no occasion for resolving the difficulties of this position; he seems to move in the direction of reducing them to the question of professional competence.

During the thirty years that intervened between the first exposition of his idea of university education in the essay on "Civilization" and his last word on the subject in the *Inaugural Address,* Mill modified the extreme conservatism of his earlier views. Of the works written in this period, the most relevant are the *Autobiography* and the essays on Comte. In the former he reviewed his own education and passed judgment upon it; in the latter he re-examined the philosophy that had influenced his thought on education during the thirties.

To his father's arduous and intensive curriculum of Greek and Latin, mathematics, logic, philosophy, history, and political economy he gives a qualified approval. He regrets not having had the discipline of experimental science and, of course, severely criticizes the omission of what he calls "the culture of the feelings" in his moving account of the almost fatal results of an education that developed the intellectual at the expense of the affective faculties. He does not share his father's enthusiasm for the monitorial system of Lancaster and Bell, finding his own experience in teaching his brothers and sisters "not favorable to the plan of teaching children by means of one another." It is remarkable that Mill, who knew the work of Rousseau, Helvetius, Pestalozzi, and other reformers, could find so little fault with an education that no doubt horrifies graduates of the schools of education of our day. They could do worse than heed his remarks:

> Much must be done, and much must be learnt, by children, for which rigid discipline, and known liability to punishment, are indispensable as means. It is, no doubt, a very laudable effort, in modern teaching, to render as much as possible of what the young are required to learn, easy and interesting to them. But when this principle is pushed to the length of not requiring them to learn anything *but* what has been made easy and interesting, one of the chief objects of education is sacrificed. I rejoice in the decline of the old brutal and tyrannical system of teaching, which, however, did succeed in enforcing habits of application; but the new, as it seems to me, is training up a race of men who will be incapable of doing anything which is disagreeable to them.[35]

His own education showed, he thought, "how much more than is commonly supposed may be taught, and well taught, in those early years which, in the common modes of what is called instruction, are little better than wasted"; it gave him "an advantage of a quarter of a century" over his contemporaries.

[34] *Ibid.*, p. 201.

[35] *Autobiography*, p. 37.

From the point of view of this essay, the *Autobiography* is most interesting for the account it gives of the change in Mill's opinion of the power of education as an agent of human progress. Although he did not lose his early faith in its efficacy, he modified his theory of how it could be made to work, as we have seen, and he became less sanguine about the speed of its accomplishments, more impressed by the magnitude of its task. He could still say, in the *Autobiography*, that "education, habit, and the cultivation of the sentiments, will make a common man dig or weave for his country," but "it is only by slow degrees, and a system of culture prolonged through successive generations, that men in general can be brought up to this point." In his lifetime he saw many of the opinions of his youth gain general recognition and many of the reforms for which he had contended put into effect, but with much less benefit to human well-being than he had anticipated. Why? "Because," he replies, "they had produced very little improvement in that which all real amelioration in the lot of mankind depends on, their intellectual and moral state." False opinions had been exchanged for true "without in the least altering the habits of mind of which false opinions are the result." The English public had thrown off certain errors, but "the general discipline of their minds, intellectually and morally," had not altered.[36] Such reflections give a melancholy tinge to the closing pages of the *Autobiography*.

What of the notion of an intellectual clerisy, of amelioration through the guidance and leadership of the cultured few? In the essay on *The Positive Philosophy of Auguste Comte*, written in 1865, he reconsiders this idea, which he had adopted without reservations in 1831, and he now sees its possible dangers. He cites passages in Comte, from which he had evidently borrowed in "The Spirit of the Age," to the effect that "the opinions of mankind should really be formed for them by an exceedingly small number of minds of the highest class," and his comment is:

> All this is, in a sense, true; but we confess our sympathy with those who feel towards it, like the man in the story, who being asked whether he admitted that six and five make eleven, refused to give an answer until he knew what use was to be made of it.[37]

Mill still believes that "it is, without doubt, the necessary condition of mankind to receive most of their opinions on the authority of those who have specially studied the matters to which they relate"; but he does not agree with Comte that the members of this authority should be associated and organized, for this would involve "nothing less than a spiritual despotism." He argues that the ascendancy of the informed will come

> when the unanimity is attained, without which it is neither desirable nor possible. It is because astronomers agree in their teaching that astronomy is trusted, and not because there is an Academy of Sciences or a Royal Society issuing decrees or passing resolutions.[38]

A comparison of the essay on Comte with the *Inaugural Address* suggests that the position he finally takes on the question of whether the grand aim of education is to bring about a "democracy of intellect" or an intellectual clerisy is somewhere between these extremes. Comte had combined the idea of public education, through the diffusion of scientific knowledge, with the notion of an authoritarian academy of positive philosophers, and Mill looked with favor upon one aspect of this combination:

> With the wide diffusion of scientific education among the whole people, demanded by M. Comte, their faith, however implicit, would not be that of ignorance: it would

[36] *Ibid.*, pp. 163, 166–67.

[37] *The Positive Philosophy of Auguste Comte* (New York, 1875), pp. 70–71.

[38] *Ibid.*, p. 91.

not be the blind submission of dunces to men of knowledge, but the intelligent deference of those who know much to those who know still more. It is those who have some knowledge of astronomy, not those who have none at all, who best appreciate how prodigiously more Lagrange or Laplace knew than themselves.[39]

Here Mill seems to have hit upon a way of reconciling the conflict between his earlier and later ideas of education, a way of solving the problem of whether the major effort in education should be devoted to a diffusion of knowledge among the masses or to the forming of great minds. It is set forth in a key passage of the *Inaugural Address,* where, instead of Comte's "wide diffusion of scientific education among the people," Mill speaks of the possibility of a widely dispersed general education, the essence of which is a combination of general and specialized knowledge. For the idea of a "general knowledge" he is indebted to Richard Whately:

> To have a general knowledge of a subject is to know only its leading truths, but to know these not superficially but thoroughly, so as to have a true conception of the subject in its great features; leaving the minor details to those who require them for the purposes of their special pursuit.[40]

Mill believes that it is not beyond the limits of human ability at the university level to combine "a minute knowledge of one or a few things with a general knowledge of many things," the one being necessary to a realization of what authoritative knowledge is, the other to a comprehensive and connected view of the main branches of knowledge:

> It is this combination which gives an enlightened public: a body of cultivated intellects, each taught by its own attainments in its own province what real knowledge is, and knowing enough of other subjects to be able to discern who are those that know them better.[41]

From this statement it would appear that the "enlightened public" is more than a clerisy and considerably less than a democracy of intellect. The idea of leadership by a gifted and superior minority is evidently retained:

> The elements of the more important studies being widely diffused, those who have reached the summits find a public capable of appreciating their superiority, and prepared to follow their lead. It is thus too that minds are formed capable of guiding and improving public opinion on the greater concerns of practical life.[42]

The conservative character of the educational program devised by Mill to fulfil this end is revealed by its close agreement on several important points with Newman's discourses on *The Idea of a University.* For Mill, as for Newman, the university is not a place of professional education: its object "is not to make skilful lawyers, or physicians, or engineers, but capable and cultivated human beings." Mill sums up in a single sentence what is, in effect, the main argument of Newman's seventh discourse, "Knowledge Viewed in Relation to Professional Skill": "Men are men before they are lawyers, or physicians, or merchants, or manufacturers; and if you make them capable and sensible men, they will make themselves capable and sensible lawyers." He is also in agreement with Newman on the scope of university instruction: ideally, the university should teach "not knowledge, but the philosophy of knowledge." The ideas and language of the following passage suggest that the authority to whom Mill refers with approval is now Newman, now Comte:

> Some have given a very wide extension to the idea of elementary instruction. According to them it is not the office of an University to give instruction in single branches of knowledge from the commencement. What the pupil should be taught here (they think), is to methodize his knowledge: to look at every separate part of it

[39] *Ibid.*, p. 90.

[40] Cavenagh, *op. cit.*, p. 142.

[41] *Ibid.*

[42] *Ibid.*, pp. 142–43.

in its relation to the other parts, and to the whole; combining the partial glimpses which he has obtained of the field of human knowledge at different points, into a general map, if I may so speak, of the entire region; observing how all knowledge is connected, how we ascend to one branch by means of another, how the higher modifies the lower, and the lower helps us to understand the higher; how every existing reality is a compound of many properties, of which each science or distinct mode of study reveals but a small part, but the whole of which must be included to enable us to know it truly as a fact in Nature, and not as a mere abstraction.[43]

The distinction between the function of school and university instruction, the description of methodized knowledge as seeing the relation of parts to the whole, the illustration of the map, recall Newman's sixth discourse, "Knowledge Viewed in Relation to Learning," while the notion of "ascent to one branch by means of another" is possibly a reference to Comte's principle of the hierarchy of the sciences, according to which the sciences should be studied in a certain order. Mill's approval of the distinction made by Newman between the function of school and university is qualified only by a realistic recognition that instruction in the schools may not be efficient enough to permit the university to confine its teaching to the philosophy of knowledge. Mill would also agree with Newman on the moral limitations of liberal education and for the same reason, that the end of liberal education is intellectual, not moral, discipline. He says that, of course, "it is a very imperfect education which trains the intelligence only, but not the will" and that "no one can dispense with an education directed expressly to the moral as well as the intellectual part of his being," but then he adds:

The subject we are now considering is not education as a whole, but scholastic education, and we must keep in view the inevitable limitations of what schools and universities can do. It is beyond their power to educate morally or religiously. Moral and religious education consist in training the feelings and the daily habits; and these are, in the main, beyond the sphere and inaccessible to the control of public education.[44]

They are, instead, within the province of the home and family and are modified by society. "The moral and religious influence which an university can exercise," he remarks, in another sentence that recalls Newman, "consists less in any express teaching, than in the pervading tone of the place."

Although he is only restating his position of twenty years before, Mill is also on the side of Newman and the Oxford reformers in all that he says—and it is a great deal—in favor not merely of retaining the classics in the position they then occupied in the curriculum but of improving their teaching and thus really increasing their importance. A third of the lecture, its longest section by far, is devoted to an elaborate defense of the study of ancient languages and literatures. He dismisses "the vexed question between the ancient languages and the modern sciences and arts" as not genuine:

This question, whether we should be taught the classics or the sciences, seems to me, I confess, very like a dispute whether painters should cultivate drawing or coloring, or, to use a more homely illustration, whether a tailor should make coats or trousers. I can only reply by the question, why not both? Can anything deserve the name of a good education which does not include literature and science too?[45]

[43] *Ibid.*, p. 135.

[44] *Ibid.*, p. 182.

[45] *Ibid.*, p. 138. In 1865, when Huxley invited Mill to join an educational society whose purpose was to promote "a system of education in which Modern Literature and Science, on the one hand, and Theology on the other, shall occupy their proper places," he declined, not only because he was opposed to the dogmatic teaching of theology, but also because he thought that "improvements in the mode of teaching" were much more needed than the introduction of modern languages and science. The latter would do no good if they were taught

To the objection that there is not time for both, Mill replies that there would be, if instruction were more proficient and the estimate of ability to learn were raised a little and if general rather than specialized knowledge were the aim. His case for ancient languages is based on the traditional arguments for their intrinsic and instrumental values: they are indispensable as intellectual disciplines and essential to the understanding of the great works of Greek and Latin literature. A knowledge of any foreign language, he holds, helps one to overcome a natural tendency to mistake words for things. The remedy evidently did not seem old-fashioned to the pupil of Jeremy Bentham, the father of modern semantics. The complex structure of Latin and Greek makes them superior to modern languages as "discipline to the intellect," their grammar being "the most elementary part of logic," their every sentence "a lesson in logic." The works of Thucydides, Aristotle, Plato, Demosthenes, Horace, Tacitus, and Quintilian are a treasure of "the wisdom of life" and must be read in the language in which they were written, for, "without knowing the language of a people, we never really know their thoughts, their feelings, and their type of character." The dialectics of Aristotle and Plato are superior to modern works "on those subjects, so vastly important to us, which remain matters of controversy, from the difficulty or impossibility of bringing them to a directly experimental test." These remarks are typical of the great host of reasons marshaled by Mill in favor of the classics, and they show the two tests that Mill applies to every study in his program: Is its pursuit an intellectual discipline? Is its content worth knowing?

The first test seems to be the more important. In his discussion of the sciences, for example, he begins by remarking the value of science as mere knowledge: "It is surely no small part of education to put us in intelligent possession of the most important and most universally interesting facts of the universe." But he implies that anyone who can read can acquire this knowledge on his own: the question is again one of what university teaching can do for the student that he cannot do for himself, and the answer is unequivocal:

> It is more important to understand the value of scientific instruction as a training and disciplining process, to fit the intellect for the proper work of a human being. Facts are the materials of our knowledge, but the mind itself is the instrument: and it is easier to acquire facts, than to judge what they prove, and how, through the facts which we know, to get to those which we want to know.[46]

From this point of view Mill organizes a program of scientific studies based on mathematics, experimental science, and logic, studied in that order. In mathematics the student has his first experience of arriving at truth by reasoning and receives his first impression of a connected body of truth. The physical sciences introduce him to "the other mode of arriving at certain truth, by observation in its most accurate form, that of experiment." From these studies, which give the practice, the student proceeds to logic, which gives the theory and which is indispensable to the avoidance of errors. These "more perfect sciences" prepare him for ventures into those that are "in a more backward state": physiology, the "most serviceable of the sciences" because its subject is man; and then psychology, into which the study of physiology naturally leads.

After the sciences should come the study of those things which "are not, in the existing state of human knowledge, the subject of a science": in Mill's order, ethics, politics, jurisprudence, and in-

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as badly as Greek and Latin (see *The Letters of John Stuart Mill*, ed. H. S. R. Elliot [2 vols.; London, 1910], pp. 43–44).

[46] Cavenagh, *op. cit.*, p. 159.

ternational law. And, since "an university exists for the purpose of laying open to each succeeding generation, as far as the conditions of the case admit, the accumulated treasure of the thoughts of mankind," the student should be taught the best that has been thought "on the great subjects of morals and religion." For these advanced studies only small beginnings can be made in the university. The teaching must not be dogmatic: "What we require to be taught . . . is to be our own teachers."

To the intellectual and moral divisions of his scheme Mill adds a third, "not less needful to the completeness of the human being," the aesthetic. He recommends the study of poetry and art not only because they "tend to keep alive and in activity the feelings they express," but also because "the mere contemplation of beauty of a high order produces in no small degree [an] elevating effect on the character" and arouses "a sense of perfection, which would make us demand from every creation of man the very utmost that it ought to give, and render us intolerant of the smallest fault in ourselves or in anything we do." It is evident that this branch of education is moral as well as aesthetic.

In the St. Andrews address Mill gave final form and expression to the ideas on education that had been developing in his mind for many years. As the examination of his other essays has shown, the philosophy of the address was a mature outgrowth of antecedent speculation and experience that followed the pattern of reaction against his earlier views. It is not surprising that this lecture was a disappointment to those among his friends and followers who, possibly because of a lack of sympathy with certain aspects of his thought, underestimated their importance to him. Just as, a few years later, the posthumous essays on nature and religion seemed to them a betrayal of rationalism, the defense of the classics in the address appeared to be a betrayal of science. "Considering that science was just beginning to raise its head, and to obtain a grudging recognition in the high places of learning," said Herbert Spencer, "it seemed to me that the note of alarm was scarcely called for."[47] In relation to the time, place, and circumstances," said Alexander Bain, "I consider [the address] to have been a mistake." He too thought that Mill was wrong in assuming "that the Greek and Roman classics had been too hardly pressed by the votaries of science, and were in some danger of being excluded from the higher teaching."[48] It is beside the point to answer that history has given the lie to this criticism, for the address is really a well-balanced exposition of the claims of all studies proper to general education. It would be difficult to find, in a work of comparable length, a more thorough account of the reasons for instruction in the subjects recommended by Mill, and this is especially true of his handling of science.

His fault, if it is a fault, is to overstate the case for most of his studies, as, indeed, his whole program is an overstatement of what it is possible to do within the limitations of the university curriculum: the idealism that inspires the whole program and sets its goal far beyond what can actually be done is reflected in the objectives of the individual studies. "We must be able, in a certain degree, to think in Greek," says Mill, "if we would represent to ourselves how a Greek thought: and this not only in the abstruse region of metaphysics, but about the political, religious, and even domestic concerns of life." If other subjects are to be given attention in proportion to their importance, even as Mill himself would have it, we shall probably have to stop short of his ideal here. But the main question raised by Mill's address concerns the value of what educational theorists of our day call "for-

[47] *An Autobiography* (2 vols.; New York, 1904), II, 183.

[48] *Op. cit.*, p. 126.

mal training." This is F. A. Cavenagh's main point of attack:

> A more serious defect is Mill's adherence to the doctrine of "formal training." On this difficult subject psychology has not altogether made up its mind. We know at any rate that the transfer from one subject of study to another is slight, and that all we can hope for is the formation of certain sentiments and habits of mind; further, that such habits will result more surely from diversified than from very specialized study.[49]

And Cavenagh gives Mill due credit for having recognized the second point in saying that "experience proves that there is no one study or pursuit, which, practised to the exclusion of all others, does not narrow and pervert the mind." But how can one say with confidence that Mill's adherence to the doctrine of "formal training" is defective if psychology has not altogether made up its mind on this subject and if, as Cavenagh admits later, "the mass of subsequent experimentation has partially cleared, but partially obscured, the issue"? Mill has at least one eminent authority of a later day on his side. In his discussion of "The Place of the Classics in Education," Alfred North Whitehead makes much more modest claims for the classics than Mill. Although he does not go so far as to say that grammar "is the most elementary part of logic," he implies an important relation, and evidently believes in "formal training":

> The analysis of thought involved in translation, English to Latin or Latin to English, imposes that type of experience which is the necessary introduction to philosophic logic. If in after life your job is to think, render thanks to Providence which ordained that, for five years of your youth, you did a Latin prose once a week and daily construed some Latin author.[50]

But the *Inaugural Address* does not merit our attention by virtue of its particular program of studies or the cogency of Mill's arguments in favor of any one of them: in the course of his speculations he came to regard "all existing institutions and social arrangements" as being, in John Austin's phrase, "merely provisional," and he would not have held that an education that provided for his day would necessarily provide for ours, especially in the face of great social change and advancements in knowledge. We have seen how, with the expansion of his own nature beyond the narrow bounds set by his father's school and with the aid of fresh insights into the transitional spirit of his age, he changed his idea of the education most needful to that age, regardless of the sectarian warfare between the patrons of different kinds of education. As the fruit of this effort to follow the truth wherever it may lead, the *Inaugural Address* will always be an inspiration to those who approach education in the spirit of which it is the symbol, of readiness to learn and to unlearn either from their own thoughts or from those of others.

[49] *Op. cit.*, p. xxv.

[50] *The Aims of Education* (New York, 1929), p. 100.

A NOTE ON THE TEACHING OF MATHEMATICS

C. Gattegno

THE teaching of mathematics is to be regarded, first and foremost, as a specialized creative activity of certain adults. This specialized creative activity involves a synthesis of three fields of study which takes place, not as a philosophical exercise, but in the actual teaching situation and its planning. The three fields are those concerned with the working of the mind; the mathematical activity that results in mathematical statements; and the needs of society, science, and technology.

It is a specialized job that can be done only by teachers of mathematics. No one else is concerned with the actual linking of the pupil's mental activity with mathematical knowledge, and it is only the teacher who needs to know how best to achieve this particular task and who recognizes the value of years of effort spent in the study of this or that part of the huge field of mathematics.

Once the problem of teaching is seen as the creation of an actual synthesis of mind, mathematics, and the needs of the future, it remains to discover how this synthesis is to be achieved. Here there are at least two fruitful lines of attack.

The first concerns mathematics itself. After sixty years of study of the foundations of mathematics, it is now recognized that mathematics is a specialized activity of certain minds, giving rise to statements which we call "mathematical" and which are most easily communicable in the esoteric language to be found in treatises and journals. That this is so is easily seen in the attitude of the working mathematician of today. He deals with structures and relationships between structures, rather than with so-called "mathematical objects." In other words, mathematicians have become aware that the "objects" of their science are particular mental constructs to which they apply their mental dynamism in order to make explicit the content involved in them by virtue of the imbedded structures. Not all constructs are susceptible of further development: some are too quickly exhausted, and some are too difficult, in the sense either that they do not show their component structures or that little experience exists of such types of construct.

Mathematics being a mental activity of a specialized type, it is obvious that it takes place in minds and that these minds have had to build their mathematics out of their mental experience. And what do we know about this experience? We know that mathematicians were once children and that mathematical structures did not exist in their minds, but merely the possibility of forming them. It is this formation of the mathematical structures that needs to be understood before the first step toward the synthesis can be taken. Mathematicians have helped by showing how certain evolved mathematical structures can be reduced to simpler ones and how recombinations produce the fundamental theories.[1]

[1] Cf. N. Bourbaki, *Éléments des mathématiques* (Paris: Hermann & Co., 1938—).

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The second line of attack concerns the mind itself. Let us consider the possibilities open to the psychologist who is aware that our mathematical knowledge has to be constructed out of our mental experience.

He can investigate at what stage of mental development the child is capable of answering this or that question in the field of mathematics. For instance, when can the child use metric properties in order to ascertain a geometrical fact? When is he capable of a generalized statement, such as that of the transitivity of equivalence relations? This line of attack is particularly exemplified in Piaget's work. For him, mathematical notions are constructs, but they are necessary constructs, and his concern is to discover how they reach their final stage, which is identical with what he himself finds in the notion.

Another possibility is to assume the existence of mathematics as seen in the school curriculum, and to investigate at what stage this or that difficulty is at a minimum and the subject capable of taking it in his stride. This is the approach of many schools of psychology in Germany, Holland, and the United States.

For the writer the situation is entirely different. Accepting the lesson given us by mathematicians, we attempt to discover an explanation of the mental activity that is valid both for the child and for the creator of mathematical notions and statements. A temporary approach which has already proved fruitful is by way of what we shall call *mental structures.* It is to be considered as temporary, since in these pages little is said of the emotional elements involved in thinking, and it is likely that affectivity plays a considerable part in our thought-processes.

A concise definition of "mental structures" is not easy, but the empirical awareness of our mental activity provides a useful starting point. Everyone knows how habits are acquired through repeated drill and increasingly frequent check to make certain that the aim set is achieved. It is the interaction between check and drill that determines whether we continue the exercise or pass on to another activity, as can easily be seen from observation of children playing marbles, hopscotch, or leapfrog or of the pianist or the scientist at work. It is in the formed set of mental patterns in which perception, action, and representation are intermingled that we find the mental structure. It is this that underlies the symbol and is the basis of our social intercourse. It is this that is the starting point for elaboration into a more developed structure. Thus, to remain in the field of mathematics, the mental structures which we call the "first integers" will be formed out of the perception that sets of objects, each with a specific use (such as pears, nails, coins, cups) can also be spoken of in terms of their cardinal numbers. When a few integers enter our awareness and are regarded in relation to one another and not to the objects, we are on the way toward forming the mental structures that we shall call "integers." These mental structures are now new elements of reality and form part of another system of communication, verbal and notational, which will develop into arithmetic.

Each moment of a mental structure is a mental structure, and there is, in general, differentiation in time between them even if the new structure is recognized as containing a previous one. Triangles are not always seen as a special case of polygons or as intersections of some planes by some solid figures.

The mental equipment common to all men is formed of perceptions and actions. Early childhood is used for the organization of experience through these two types of structuration, which are intermingled from the start. The mental structures thus obtained will be the material to be used in the formation of mathematical structures as discovered by mathematicians. But not all mental structures of a mathematical character are singled out by mathematicians, since for

them there are sets of primitive notions. For instance, the criteria for recognition of membership of a set are assumed, although for the psychologist it is an elaborate problem to decide whether $a \epsilon A$ because of this or that attribute. This distinction between the working mathematician and the psychologist has its bearing upon teaching. Though today mathematicians use sets as primitive notions, it took generations of thinkers to arrive at the point at which a set could be conceived as a mathematical notion. Mental structures are richer than mathematical structures, but the latter are "freer," in that they attain wider fields of existence. For instance, each integer is a mathematical structure which, when it is involved in the life of its users, is a mental structure that intervenes in many situations but loses its power of being replaced by all its equivalent definitions in terms of the other integers. It does not appear as being linked with these but with a different kind of reality; its mathematical character is blurred. In the case of the smaller numbers, these two aspects are evident when, on a shopping expedition, we pay for what we buy and add up our expenses; in the first case money is a medium of exchange, in the second it is numbers.

The evolution of certain mental structures into mathematical structures is not from the simple to the complex, but from mental structures involving perception and action to mental structures in which these are symbolically preserved. A useful example is that of the transition from measuring the angles of a drawn triangle to the statement of the constancy of their sum in any Euclidean triangle.

To draw is clearly to combine perception and action in a specific way leading to the awareness of a mental structure as their combined substitute. To measure angles is also to combine perception and action in another specific way, and it is only when we are struck by the astonishing fact that the result of our actions always falls between numbers very close to 180° that we begin to wonder whether this is a property of the mathematical structure which is not any one of the drawn triangles but a substitute for all triangles. But what is meant by the statement that the sum of the angles of a triangle that is not drawn is 180°? This question has no answer unless we see that mathematical structures are specialized mental structures, those whose link with perception and action has become potential instead of actual. We shall be able to substitute for the actual drawing a potential drawing by producing a triangle as an organized mental structure; for the angles, the set of all the equal angles that can be obtained by displacements preserving their magnitude; for their sum, the angle obtained by eliminating the common sides of the adjacent angles we can form and inquiring whether the exterior sides are on one line. The mental activity thus displayed is called a "formal" proof, as distinct from the other, which is empirical. In our view it is quite otherwise, and the two proofs are concerned with two levels of awareness of what our mathematical mental structures are. The formal proof takes place with mental substitutes which are those mental structures in which perception and action are felt to be remote but are, in fact, potentially contained. Thus the formal proof is neither more convincing nor more generalized than the empirical. It concerns material extracted by an ordinary mental process from the set of substitutes for combined perception and action and seems different only until we question our conviction and discover that it is a matter of agreement that makes mathematical structures of a different essence. If we look closer, as the psychologist does, we find that our thought not only can "abstract" but can also return to its more primitive mental structures.

The word "abstraction" is adequate to express the formation of mental structures that apparently rest upon themselves rather than upon the actual material of perception, but abstraction is not

a process that can be dated in life. It is active all the time that the mind is actively experiencing. It is, in fact, the process of producing mental structures. Language learning, symbolic play, and dreams use substitutes abstracted from the process of objectivation or creation of structures. From the start, human life puts the child in front of a man-made universe, and both the natural world and the social world in which he lives require him to be able to make judgments involving perception and action combined in a multiplicity of ways.

When children recognize that their life consists in some measure in this process of forming mental structures that become increasingly abstract in order to meet ever wider challenges, they are aware, without its actually being expressed, that they are potentially mathematical creators. For, indeed, those among us who specialize in the formation of mathematical structures, more or less particular, more or less involving known structures, more or less productive, are as truly creators as the artists who form particular plastic structures with special properties.

Owing to the multiplicity of the elements involved, the relationship between mental and mathematical activity may still be somewhat obscure, but this discussion may have simplified the situation sufficiently for us to make further dogmatic statements.

In contrast to other psychologists and teachers of mathematics, we consider mathematics as a creation of the mind of mathematicians, and the learning of mathematics as the creation, by each individual student, of mental structures akin to those of the mathematician. It therefore becomes possible to define the first step of the synthesis we are seeking as the organization of the child's experience in such a way that he becomes aware that his mental activity yields mathematical structures having their own organization, which organization is called "mathematics."

It is the teacher himself who must first make this synthesis in his own mind. For him, however, the process is rather the reverse of the child's. The teacher must see that mathematical structures are mental structures and must be able so to disentangle them that he can see at what stage of his pupils' experience he can make them aware of the components involved. It is possible to develop such a study in the form of a "functional syllabus," and the writer has done so in relation to the English grammar-school syllabus. One or two illustrations will suffice here.

Let us consider the teaching of simultaneous equations to grammar-school pupils of thirteen to fourteen years of age. We begin with a game: A thinks of (but does not announce) a number, and B announces a number. Then C asks A to increase (or diminish or multiply) his number by B's, and to announce the result. The answer—A's original "unknown" number—is obtained by all the pupils when they "undo" what has been done. This, repeated and complicated, leads to the solution of equations in one unknown (either numerical or literal). Moreover, the equations need not be linear. Quadratics can also be solved, first in the set of non-negative numbers and later in the set of all numbers. The game is then extended, with two people thinking up numbers and the teacher adding them. This indeterminate equation can be solved by the two pupils in question, while the others can give only the two equalities $x = A - y$ or $y = A - x$. If we *all* want to find the two numbers, we need another equation; and we begin by studying, e.g., the pattern $x + y = 3$, $x - y = 1$. The solution is immediate by inspection. It is almost as immediate if the right-hand sides are, respectively, 30 and 10, or 300 and 100. But if they are, respectively, 30.1 and 10.1, the solution becomes possible only through an awareness that the answers to the previous pairs of equations are obtained by adding and subtracting the two equations.

When someone in the class discovers and expresses this fact, several pupils see it immediately. Then a whole lesson is spent in establishing the method, keeping the left-hand sides $x+y$ and $x-y$, respectively, and changing the right-hand sides. The numbers are replaced by letters, then by polynomials in different letters. When this has been mastered—and no more than one period is required for this in any form in a grammar school—the work that follows consists in discovering all the permissible changes of pattern, i.e., that the choice of x and y is immaterial; that, if powers of x and y are used instead of x and y, a further step is involved (extracting the required root at the end); and that the numerical values of the coefficients of x and y do not need to be 1 and 1 but must be the same in the two equations (though not the same for the two letters). Thus, after two lessons the class can solve equations of the following type by inspection:

$$A X^{\alpha}+B Y^{b}=K^{\alpha}+L^{\beta}+M^{\gamma},$$

$$A X^{\alpha}-B Y^{b}=P^{n}+Q^{m}+R^{s}.$$

The operations can be correctly carried out by all pupils, and the answers,

$$X=\sqrt[a]{\frac{K^{\alpha}+L^{\beta}+M^{\gamma}+P^{n}+Q^{m}+R^{s}}{2A}},$$

$$Y=\sqrt[b]{\frac{K^{\alpha}+L^{\beta}+M^{\gamma}-P^{n}-Q^{m}-R^{s}}{2B}},$$

can be checked by reversing the operations.

The next step is to establish that the order of the equations and the relative arrangements of the right- and left-hand sides are also immaterial. Thereafter the pupils solve

$$M=A X^{\alpha}-B Y^{b},$$

$$B Y^{b}+A X^{\alpha}=N,$$

and all the other permissible variants either by explicitly reducing to previous forms or by doing so mentally. This having been mastered (in one lesson), fractional coefficients are introduced in all these types of equation. In five lessons the class is ready to solve a wide class of pairs of simultaneous equations (which they themselves have constructed from the start), expanding the initial pattern to its extreme degree by all permissible operations at their disposal. We are still dealing, it is true, with the same pattern of coefficients, but all changes within this restriction are experienced as the dynamics of the situation. Mental structures are expanded to the full with mathematics that is related to the child's previous experience.

The step forward to the general solution of simultaneous equations involves the extension of the number set to that of all numbers, and of the pattern to that involving arbitrary coefficients. The difficulties here are smaller than previously. We only need combine the existing dynamics with two new operations: to multiply equations by suitable coefficients, thus producing patterns comparable to the original one, and to note that negative expressions are susceptible of the same treatment as positive ones.

The dynamics of the original case can be described as the passage from

$$ax+by=c, \qquad x=\frac{c+d}{2a},$$

to

$$ax-by=d, \qquad y=\frac{c-d}{2b};$$

and that of the general one, as follows:

$$ax+by=c,$$
$$a'x+b'y=c',$$

to

$$aa'x+a'by=ca',$$
$$-aa'x-ab'y=-c'a,$$

to

$$aa'x+a'by=ca',$$
$$(a'b-ab')y=ca'-ac',$$

to

$$ax+by=c,$$
$$y=\frac{ca'-ac'}{a'b-ab'},$$

to

$$ax + by = c\,,$$
$$-by = -b\,\frac{ca' - ac'}{a'b - ab'}$$

to

$$ax = c - \frac{ca' - ac'}{a'b - ab'}\,b\,,$$
$$y = \frac{ca' - ac'}{a'b - ab'}\,,$$

and

$$x = \frac{cb' - bc'}{a'b - ab'}\,,$$
$$y = \frac{ca' - ac'}{a'b - ab'}\,.$$

Each system is deduced from the preceding one by multiplying by appropriate coefficients or by forming a linear combination of the two equations. This analysis shows where careful planning of the lessons is required. There are two delicate points in the construction of the mechanism: first, the transition from two pairs of numerically equal coefficients to one pair; and, second, the forming of linear combinations of equations. A comparison of systems such as the following shows that equations which are merely proportional lead to identical answers and that any one equation can be the representative of all:

$$x + y = 7, \qquad 3x + 3y = 21,$$
$$x - y = 5; \qquad 3x - 3y = 15;$$

$$3x + 3y = 21, \qquad x + y = 7,$$
$$x - y = 5; \qquad 3x - 3y = 15.$$

The comparison of the answers and of the new equations obtained by multiplication does not supply sufficient awareness. The main point to be established is that there are infinitely many equivalent pairs of equations. It is awareness of *this* fact that is essential for the freeing of the children's minds.

The true mathematical value of the study of simultaneous equations does not lie in the pupils' capacity to solve automatically any pair of such equations. It lies rather in their understanding of the compatibility of data, of the distinction between unicity of solutions and indeterminacy, and of the possible extension of the method to any system of linear equations. It is in the translation of this awareness of the mathematician into a system of lessons involving mental structures and the mental activity of our pupils that our functional syllabus can make its contribution to the improvement of the teaching of mathematics.

Our second illustration concerns geometry. We do not wish to teach Euclidean geometry as a deductive system. We want to give our pupils geometrical experience, a capacity for making statements about properties discovered in the context of spatial experience. Our pupils can see that a pair of compasses used in a certain way enables us to draw a figure we may call a "circle." They see that we can use one center and various radii and produce a pattern of concentric circles; or varying centers and the same radius; or varying centers and varying radii. This gives them experience of the three degrees of freedom of the circle in the plane. Combining these procedures in various ways indicates how the drawing of a circle is affected by various conditions. For example, the circle must pass through a given point, or through two given points, or through three, etc. It is a striking experience to discover that four points are not, in general, on any one circle and that three points not on a line fix a circle. All this can be obtained as part of the organization of perception and action. By selecting pairs of circles from two systems of concentric circles, it is further possible to provide the excitement of discovering that, if corresponding radii are equal, the points of intersection seem to be on a straight line; that, if the sum of the radii is constant, the points are on an ellipse; etc.

Loci are dynamic patterns defined by a property and defining a property. It is possible to give our pupils experience of a geometrical nature when in their ac-

tions they perceive invariant properties. It is an amazing fact that the radius of the circle can be taken six times on the circumference and produces a hexagon; that the figure can be rotated in six different ways and superimpose the hexagon, while the circle is invariant for any rotation round the center. *Group properties* thus emerge quite early and may play a part in future work. We have to introduce "abstracted" figures contained in patterns and their properties contained in given situations. For example, the circle and the hexagon bring in equilateral triangles, rhombuses, trapezia, and rectangles, when vertices are joined in different ways. These figures are duplicated under rotation around the center, and six different positions are experienced. Metric properties for sides and angles can be abstracted and experience in statements obtained.

These few examples show that greater freedom in our work as teachers in no way diminishes the possibility of our pupils becoming mathematicians if they so choose. On the contrary, through the functional syllabus they enjoy *their* creation of mathematical structures and take it as far as time and interest allow. The results are as securely imbedded in their experience, in their minds, as is their capacity to walk and talk. After all, it is our *attitude* toward our mental structures that produces mathematical structures. Once the latter exist in our awareness and are recognized as being of the same nature as our other mental equipment, there is no shyness in considering them, talking about them, expanding them. This is in no way idealistic; it takes place in all the classes we teach in London.

Mental structures are the lot of everyone. Some of them are mathematical because they are looked at by the mind in a particular way. It is our task as teachers to eliminate preconceived ideas and to make our pupils aware of their capacity to evolve the attitude that produces mathematics out of their mental activity. Our testimony is that this is not only possible but remarkably easy when we ourselves believe the child and ourselves to be creative minds.

So far we have made the link between mental and mathematical structures. There is a third term in our synthesis: the needs of the future. We have to discover means of linking the mental activity that is mathematical with a world possibly different in content from that in which the adult generation of today was born.

Politically, the world has changed in the last forty years from a situation of European supremacy to one in which new and powerful countries are developing new ways of life—ways that to our generation are apparently conflicting. But it is also true that science and technology are offering new challenges that are not necessarily different in the various countries. For many people the future is obscure, and it seems absurd and unreal to plan for it. However, it is obviously equally absurd and unreal to imagine the world as continuing as it was forty years ago.

The teacher's function is clearly to equip his pupils for a life which will take place in the future. He must make assumptions about this future and plan for it. Otherwise he must accept a special responsibility for any shortcomings in the next generation's ability to adapt to the new conditions.

The Commission considers that it is possible to begin a study of the actual demands of the future and sees it as a duty to undertake this part of the synthesis earnestly and with all competence. In 1953 a seminar will be held in Holland to examine those aspects of the challenge of the future that are already apparent and their relationship to the functional syllabus.

In conclusion we would say that human endeavors require human actions

and that the specialized function of preparing the young for life in an industrialized world puts a particular responsibility on the science and mathematics teachers who are their guides and to whom society intrusts the task of that preparation. If these teachers do not do it, it will not be done.

COMPOSITION AND LOGIC

Henry W. Sams

CURRENTLY popular among textbooks in composition is one which contains a thirty-four-page chapter on the subject of logic and which in an appendix ventures an explanation of the distribution of terms. But for some reason its authors have chosen to avoid the word "logic," and in their index the following entry appears: "Logic; *see* Reasoning." Another often-used book includes twenty pages on logic and furnishes definitions of the words "induction," "deduction," and "syllogism." It affords a number of rules for being logical, but they seem to have been chosen with an eye to custom rather than to science. The older handbooks usually include a rule or two, with examples: "*Wrong:* I read where Texas fever was once a scourge." "*Illogical:* The life of a hod-carrier is sometimes happier than a prince." Another concise handbook has two rules of logic which may be summarized as follows: (1) Be logical. (2) Don't be illogical.

The showing is not an impressive one. But it is a showing. The men who prepared these texts should not be blamed for its deficiencies; the strictest logician could hardly expect them to store their books with goods that will not move. Their inadequacy is too frank to be invidious.

But recently there have been signs of a more robust interest in logic.[1] Books intended for composition courses and containing thorough and professional treatment of elementary logic have been published and adopted. Among textbooks of less adventurous design, recent ones devote more space, and often more thought, to logic than did the corresponding texts of ten or twenty years ago. Among the books of readings, those which by their selections and arrangements invite analysis and systematic reordering of ideas have gained favor.

These signs of interest may be taken to reflect increasing concern for the purposes and criteria of writing with which logic is useful. If, in fact, this concern is increasing, it is timely to consider the kinds and quantity of formal logic applicable to the writing course and, even more important, the modes of relationship which exist between logical thinking and discursive prose.

The second of these questions is the prior one. What is the bridge between formal inference and composition? To assume that the answer is obvious or easy is a mistake. There are, in fact, strong arguments to the effect that no such bridge exists.

For example, it is clear that an ungrammatical sentence may be logical and that an illogical sentence may be grammatical.

Good guys don't steal.
He is a good guy.
He don't steal.

Some teachers of composition are Doctors of Philosophy
X is a Doctor of Philosophy.
X is a teacher of composition.

Some dogs have fuzzy tails.
My dog has a fuzzy tail.
My dog is some dog![2]

[1] "Report of Workshop No. 15: Logic in the Freshman Course," *College Composition and Communication*, II (December, 1951), 29.

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[2] This masterpiece of il-logic was invented for the amusement of his colleagues by Lewis Smith.

Logic may be good or bad without reference to correctness of grammar. In fact, criteria of logic and of grammar may lead to contradictory judgments; a sentence quoted earlier—"I read where Texas fever was once a scourge"—seems to be unacceptable from one point of view and quite acceptable from another. To say that "the life of a hod-carrier is sometimes happier than a prince"[3] may be regarded as grammatically unexceptionable, but the logic of common sense winces at so blithe a disregard for habitual categories.

There is something to be said for the view which holds that grammar is one thing, logic another. To look for a simple linkage between the two systems is to look for something which is not necessarily there.[4]

[3] Suggested correction: *for* life *read* wife.

[4] In a paper entitled "The Logic of Some Common Conjunctions," as yet unpublished, Louis Crompton finds that "the conventional grammatical distinctions between subordinate conjunctions (if, when, although, . . .) and coordinate conjunctions (and, or, but, . . .) leads to *no* corresponding logical distinction." It is quite possible that, if Mr. Crompton should extend his studies, he would find the distinctions between transitive and intransitive verbs, and between the tenses, voices, and moods of verbs, equally unmanageable in the system of symbols which he chooses to employ. The implication of his work is clearly this: Logic and grammar are independent systems.

But there are two sides to this question. Systematic descriptions of syntax may be devised for hypothetical languages which have no existential reference ("Pirots karulize elatically"), and these systems may be brought into detailed correspondence with appropriate, systematic descriptions of logic. This kind of thing appears in speculations on "logical syntax" like those of Rudolf Carnap (*The Logical Syntax of Language*, trans. Amethe Smeaton [London: Kegan Paul, 1937], pp. 1–3). However, Professor Carnap is careful to say that "in consequence of the unsystematic and logically imperfect structure of the natural word-languages (such as German and Latin), the statement of their formal rules of formation and transformation would be so complicated that it would hardly be feasible in practice."

Logicians may sometimes envision their science as encompassing the chaotic richness of "natural word-languages"; contrariwise, students and teachers of natural languages may dream of perfectly logical spech. The two impulses may be likened to those of a musician who at one moment yearns for an impossible multiplication of overtones and at another for a single, pure, unramified tonality. Both desires must have their frustrations.

Another objection may be raised on the ground that the relationships of logic prove inadequate to the task of describing literary structures. Few arguments can be contained within a logical formulation. The net product of discourse is seldom reducible to a "statement," "proposition," or "conclusion." Compilers of anthologies sometimes undertake to find readings appropriate for the teaching of logic and assume that the proper readings will be those in which the syllogism functions as the determinant of literary form. Oftentimes they decide upon T. H. Huxley's "Method of Scientific Investigation." But this essay may not be confined in a syllogism. It is chosen, as it were, by default, because Huxley happened to be looking for the same thing that the anthologist is looking for. The Declaration of Independence is a nearly perfect example of discursive inference, but it belongs to a rather special genre of literary composition; one must stretch the word "essay" to contain it. As for essayists to whose works the anthologist is led by current tastes—such writers as Rebecca West, George Orwell, Arthur Koestler—they seem almost deliberately to hunt out paradoxes and avoid neat summary.

The teacher who denies the equation of logic with literary form usually makes good his claims. Essays arrive less frequently at "conclusion" or "hypothesis," in the logician's sense, than at a position or attitude in which a number of conclusions and hypotheses may be implied. There are more ways, and better ways, of describing literary form than logic can furnish. Although inductions and syllogisms may occur within a work, few literary works can be said to stand within an explicit logical formulation.

A third objection may be raised, and

in some ways it is the most damaging of all. This is the direct attack upon logic as an imperfect and fallible science. If the syllogism is so marvelous an instrument, why have not those who are masters of it subdued us to agreement? Some of the shrewdest of modern logicians have condemned the habits of unimaginative logical formulation and manipulation as dangerous sources of error and as causes of philosophical blindness.[5] Others point out the imperfect separation between Aristotle's logic and his language and call attention to subtleties of relationship and quantity which the ancient logic is incapable of representing.

If logic is described as capable of more than a relatively superior accuracy, it is misrepresented. In effect, it is no more than a discipline of thought. Those persons who are pleased to be satisfied with undisciplined thought may not be categorically identified with error. Validity is no guaranty of wisdom.

These objections have force. And to them must be added further arguments arising from the nature of language as composition teachers think of it. The problem is not that of adding the complexity of logic to the simplicity of writing but that of joining one complexity with another. Composition is itself composite and capable of definition in a variety of ways. Differences of purpose and of criteria divide considerations of writing into several imperfectly harmonious kinds.

Writing may be thought of as a means of transferring ideas from a person who has them to persons who do not. To some teachers this may seem the standard situation of students in composition courses. According to this conception of his role, the writer must study his reader and his language and bring the two together. The problem is one of communication. Students know what to say, but they do not know how to say it. Their teacher evokes material which they may be presumed to have and then assists them in overcoming grammatical, technical, mechanical, and social difficulties which lie between them and their audience—that is, which lie between them and himself.

From another point of view, writing may be envisioned as a mode of thought. The student writer, far from knowing what to say, is thought of as for a limited number of years engaged to do nothing but seek for knowledge. He is an assimilator, not a dispenser. For him writing may seem an instrument and a discipline of discovery. He writes to make up his own mind as well as to inform his teacher. He knows that pencil and paper invite complete sentences, articulate paragraphs, and certain qualities mysteriously named unity, coherence, and emphasis. Pencil and paper will help to teach him what and how to think.

There is still a third way: some students and their teachers envision writing as expression, as a purging of the brain. This is a school of creative writing and one to which a great many persons attach themselves sporadically or temporarily, especially when confronted with students of unusual talent.

But, whatever the conception of writing, the facts and theories of language play their crucial role. There can be neither communication, nor thought, nor expression except in obedience to the requirements of words. In fact, the difficulties presented by dictionary and manual sometimes obscure distinctions of purpose; the teacher may be tempted to decide that he can hope for no more than a little stenographic knowledge.

In teaching language, he must appeal to the criteria which linguists furnish him, and he receives these criteria in the forms of prescriptive rule, of usage, and of function. It is seldom that he invokes reasons of all three kinds in order to cor-

[5] John Dewey, *Logic, the Theory of Enquiry* (New York: Henry Holt & Co., 1938), p. 65: "The very fitness of the Aristotelian logical organon in respect to the culture and common sense of a certain group in the period in which it was formulated unfits it to be the logical formulation of not only the science but even the common sense of the present cultural epoch."

rect a single error, but not infrequently he could do so if he chose. For example, in condemning a "comma splice," he could invoke his authority, he could explain that a full stop is customary between independent clauses, and he could point out that without the signal of a full stop the reader would stumble on into the next clause expecting grammatical subordination but finding no such thing.

Some teachers prefer prescriptive to functional criteria. Others combine usage with function and discount the force of prescriptive rule. Furthermore, the various kinds and combinations of criteria may be associated with communication, thought, and expression in a variety of assortments. Instructors may be heard to characterize one another in terms of appropriate combinations of these six ideas of writing and of language. Less happily, instructors may be heard arguing over specific points of linguistic practice without perceiving the source of difference in their respective conceptions of how the six should be related.

The routine of assigning and correcting themes, discussing readings, framing examinations, and conducting conferences may move along from day to day without too great an embarrassment from the varieties of faculty opinion within these categories. Even when differences arise, no one need be routed from the argument, for every position within the defined range of possibilities is capable of well-documented defense. It is true, however, that some positions at any given moment may be looked upon with more general favor. For example, a combination of prescriptive rule with the purpose of expression may now seem reactionary. On the other hand, communication has been popular in recent years, especially when joined with the criteria of usage.

Although varieties of philosophy may live together in a single group of teachers, they cannot do so without compromise. Although there is an extensive area on which they can agree pragmatically, their compromise has nevertheless an important effect.

Anyone who proposes an expansion of the composition course to include new or neglected materials and disciplines must reckon, not with one or several of the combinations, but with all of them. So it is with logic. Staffs of teachers are social bodies. Even the cantankerous individual thinks twice before he jeopardizes the truce. Material which seems inimical to one conception of the teacher's job may encounter resistance from all. The circumstances are such that teachers may vigorously resist materials impertinent for only some of their colleagues and then paradoxically find agreement in the use of materials which are impertinent from every point of view. For example, staffs may make researches in literary history and linguistic science far beyond the requirements of their professional activities—may even undertake them as community enterprises—and at the same time refuse to consider aspects of rhetorical study important to views of their activity that some of them hold. This tendency is not diminished by the institutional situation of composition teachers, some of whom live in hope that the disproportion of their literary and linguistic wisdom to their opportunities for using it may not go unnoticed.

This is the state of affairs which conditions the consideration of novel procedures or disciplines for inclusion in the writing programs. An example of its effect is the story of elementary semantics during recent years. Although if pursued for its own sake it leads to fascinations not strictly contained by the criteria and purposes of student writing, the study of semantics is at certain levels germane to the study of English composition.[6] But its introduction was greeted with dispro-

[6] Monroe C. Beardsley, "Logic in Composition," *Journal of General Education*, V (1951), 261. Precisely the same observations, of course, may be justly made with regard to logic, grammar, spelling, or literary history. Considered as ends in themselves, all these valuable studies lead toward pedantry.

portionate intensities of welcome and resistance. Another example may well be the study of formal logic, whose reception has been salted with arguments. Teachers of composition who now listen complacently to papers on the theories of meaning will vehemently deny even tangential pertinence to a paper on the nature of induction. But even semantics may be shunned for a well-documented note on the domestic affairs of John Milton.

Interest in literary biography to the exclusion of logic is amiable and human—although the exclusion is one in which Milton did not participate—and on general grounds no one need quarrel with it. The teacher whose sole end is communication and whose criteria are prescriptive rules can have little use for logic. For him the products of logic are assumed as given before his work begins. He may tolerate, but he cannot welcome, the introduction of an alien and formidable science in his sphere of activity. And since graduate seminars in logic are conducted by a remote agency known as the department of philosophy, there is little institutional pressure on him to reconsider.

But if to prefer biography and exclude logic be rationalized as a duty of the composition teacher, prerequisite to professional decency, a question may legitimately be raised. The teacher who favors criteria of function and who admits into his course some concern for exploratory writing, for writing as thought, must at times not only tolerate the discussion of logic but also feel an acute need for it. As scholar and as human being he may be a devoted Miltonist, but as a teacher of writing he is compelled to know logic. It is through teachers of this sort that logic has always retained at least a shadowy and fragmentary life in composition courses. They cannot without gross violation of the truce force logic into prominence, but neither can they let it die.

From this precarious footing the study of logic in the composition course may advance or remain the same. It can hardly decline. Those who advocate its advance will be met by all the difficulties and objections which have been enumerated in the first, the pessimistic, part of this paper. They will encounter practicable conceptions of the teaching of writing which are actively opposed to considerations of thought. They will be told that logic is impertinent to grammar and, therefore, to the course. They will study essays displaying a multitude of engaging and persuasive forms which the terms of formal logic are incapable of describing. They will repeatedly find themselves in the ludicrous position of pleading with their colleagues to learn persuasion and failing to make the point!

They will be well advised, therefore, to choose their topics cautiously. Little is to be gained by declaring the indispensability of something that everyone gets along nicely without. To argue effectively for logic, one should find his premises, not in his ideas of what composition should be, but in the practice of composition as it is.

The place of logic in the standard rhetorics and handbooks has already been noted. But there is another part of the texts which, although it does not bear the name of logic, may in fact be the point in composition courses at which serious work on rules of thought is customarily introduced. Under the heading "paragraph development" the relevance[7] of detail to topic idea, of parts to whole, becomes the center of concern. As it is usually treated, this is essentially a concern with logic. It pertains to a structure too extensive for grammar, too confining for "literary form," and its validity, although imperfect, is the best that language can afford.

Usually the student is introduced to paragraph development by way of an

[7] *Ibid.*, p. 256: ". . . it seems to me that, as soon as we begin talking clearly and helpfully to the student about relevance, we are talking *logic*."

enumeration of "methods," and enumerations provided in the various textbooks conform with a more or less standard pattern. A composite list, based on three popular handbooks, includes the following terms: (1) examples, (2) definitions, (3) causes and effects, (4) comparison and contrast, and (5) a combination of methods.[8] There are differences between the explanations and illustrations which accompany the various lists, but fundamental to all of them is an assumption that relevance is capable of being analyzed into a limited number of distinguishable relationships, that is, into a logical system.

Drill on the methods of paragraph development is usually expected to result in a clear articulation of parts within the essay. But it is often the impression of teachers, as well as of students, that the parts do not differ in nature from the essay which contains them. The paragraph, or cluster of paragraphs, which constitutes a part is assumed to be identical with the essay itself in every respect except that of magnitude. On this assumption one might consider the part to be an elementary or preliminary mode of composition, and facility with the part would seem to afford sure promise of facility in larger enterprises.

As a matter of fact, the parts of superior essays often differ radically from their containing structures. They are different not only in size but in nature as well. For example, the essayist who addresses himself to the problem of academic freedom may find it wise to adopt a position defined by limits called "freedom" and "responsibility"; these limits will control the form of his essay as a whole. However, he may in parts of his essay be quite dogmatic, affirming in one place his unqualified support, moral and fiscal, of the California nonjurors and in another place his condemnation of any colleague proved guilty of setting fire to the library.

The essential difference may be referred to as a difference between opinion and fact. Essays deal with opinion; parts of essays deal often with facts. One ancient philosopher made the distinction in terms of open and closed questions. Essays, he said in effect, are addressed to problems which cannot be answered "Yes" or "No." Logic yields "Yes" and "No" answers. It yields facts. For this reason logic may be regarded as applicable to paragraphs and clusters of paragraphs, although it prove inapplicable to the essay as a whole. Also, for this reason, the art of writing, which is not a science, may yet have science in it.

Here it is appropriate to return to the question of what kind of logic, and how much, is desirable for the teaching of composition. One of the difficulties of the question arises from developments in the field of logic itself. Relatively simple conceptions of deduction and induction which once served not only for rhetoric but for the science of logic as it was then understood have been more recently forced into a position of insignificance by systems of mathematical probability and inference. In current practice the consideration of "formal logic" is no more than an introduction to highly sophisticated matters of "applied logic" and "scientific method." Modern logic finds kindred disciplines in mathematics and physics rather than in language.

Teachers of composition who are interested in the adaptation of logic to their work turn naturally to colleagues engaged professionally in the study of logic.

[8] Although these terms have become so commonplace as to be habitual, they by no means constitute the only possible formulation of relationships. For a random example, John Stuart Mill's discussion (*System of Logic*, Book I, chap. v, Part 5) "Of the Import of Propositions" lists in a pertinent context five practicable terms: "Existence, co-existence, sequence, causation, resemblance." Mill's terms have the advantages of easy verbal exemplification and of rational order. But one should be cautious in adopting any formulation whatever, for its philosophic effects may be extensive, particularly for students who are not aware that they exist. No indoctrination is more invidious than that of teaching analytical procedures uncritically.

What they find is not always what they are looking for. Logic oriented to mathematics is not identical with logic oriented to language. In fact, the old verbal logic has in some instances dropped almost out of sight, as though between calculus and discourse there could be no middle ground.

Language, like logic, has its limitations. Surely the primary condition of all work in composition is this: that students cannot be taught to do with words things which by their nature words cannot do. For this reason the kind of logic appropriate for composition may be simply defined as the verbal kind, the kind formulated in ancient times, clarified by generations of adapters, and currently preserved as "elementary" or "formal" logic by logicians who find themselves uncomfortable in a predominantly quantitative, mathematical environment. The new logician works within narrower tolerances than the old, but for the purposes of discursive student prose, the old tolerances are satisfactory. There is as yet no practical necessity for the composition teacher to explore the mysteries of symbolic logic.

The answer to the question "how much" of logic composition requires depends upon a number of factors. It is fair to suppose that the methods of paragraph development usually enumerated in the handbooks afford a key. If the teacher wishes his students to comprehend four types of relevance, then he needs enough logic to control those four types, and no more.

Perhaps there was in history a time when the phrase "methods of paragraph development" was recognizable as a euphemism, a convenient way of invoking logic without naming it. If so, there should still be some degree of correspondence between the two things.

What, for example, may one say about "examples" as a form of logic? Some of the textbooks include brief explanations of the terms:

> Development by examples is one of the most effective ways of enlarging on a topic sentence. Examples tell the reader that the writer is drawing conclusions based upon more than one instance; hence examples show the validity of the author's logic.

All textbooks include one or more exemplary paragraphs for each term. In one book the following paragraph, without explanation or comment, is used to state the meaning of "examples":

> Children are precocious in their attitude toward stories. They know what they like and why they like it, and thus are perfectly willing to express their opinions with brutal frankness. Once a storyteller gathered a group of six-year-olds around her and began in the accustomed fashion: "Once upon a time. . . ." To this, one of the moppets remarked quickly, "I've already heard that one!"

These two indications of the meaning of the word "examples" as it is used in the handbooks are not in agreement, and neither can be regarded as exhausting the subject. Students might embark upon an elaborate critique of them, with multiplication of instances and systematic expansion of the explanation. Anyone who chose to pursue this task would find useful criteria in that part of the traditional logic which is usually called "induction."

But it is not necessary to assume that because examples resemble induction they must be used only for purposes of "proof." Definitive proof in the inductive mode is impracticable even for the mathematician. To make a rational base for choice or avoidance, belief or disbelief, and thereby to make rational action possible—this is all that anyone can expect of the most meticulous induction. But for this limited purpose examples must be true, representative, and of sufficient number. And in the most casual, personal writing, as well as in statistical research, these rules are sound. False, disorderly, and inadequate examples are pointless in all circumstances. There is more than logic, of course, in the effec-

tive use of examples. Everyone has encountered sound logic in creaky prose. But it is only fair to allow that the fault is not in the logic but in spite of it.

Another method of paragraph development is that described by the word "definition." Here also the echoes of logic are clear.

> In elaboration by definition the idea to be defined is usually expressed in general terms. It is then restated in other terms, terms which are more familiar to the reader.

No matter what approach one uses, definition is a vexed and difficult matter. So long as the meaning of meaning remains obscure, there will be a variety of opinions concerning the requirements of definition. And yet one simple notion persists or recurs whenever definition is considered, and that is the notion of "sets," "categories," or general "classes" of things. Many definitions begin with the assignment of the word to be defined to a class, as "X is a member of class Y." Many definitions contain as an essential ingredient an idea capable of formulation as a "categorical" statement. Therefore, they contain the first requisite of the categorical syllogism and invite the procedures of thought implicit in syllogistic reasoning.

Other definitions begin with the assignment of a property to a particular subject, as in the classic example—"Man is a being capable of learning grammar." Even though teachers of composition may at times have reason to doubt the truth of this premise, the facility with which it leads to inference is plain enough. Definitions create contexts. Because of them statements have relevance to one another. And as a general rule the most profitable way of describing, controlling, or testing relevancies among statements is the way of formal inference.

Examples of definition as a method of paragraph development are quoted in many textbooks. They contain, either explicitly or by implication, a controlling, context-making premise. One of these paragraphs, drawn from Samuel E. Morison's *Ancient Classics in a Modern Democracy,* serves its purpose clearly:

> Style, defined by Whitehead as "an aesthetic sense, based on admiration for the direct attainment of a foreseen end, simply and without waste," is above all things the mark of an educated man or woman; and never has there been found anything equal to the literature of Rome and Greece for inculcating that sense of *style* which is one of the best things you can acquire from education. Style, whether in art, literature, science, engineering, or business, has the same qualities, attainment and restraint. And style is not only the last acquirement of the educated mind; but the most useful. It pervades the whole being. The administrator with a sense of style economizes his material, and erects structures that have intrinsic beauty through their perfect adaptation to the function expected of them. The writer with a sense of style uses not a word too few or too many, and employs the right words in the right combination, to express his thought. "Style," says Whitehead, "is the ultimate morality of the mind." A democratic society not only needs style more than does any other, but appreciates it more, as a rare quality.

Analysis of this paragraph is not difficult, for its parts are distinct; but, if the analysis is pressed and the relationships of parts established, the discipline of the passage emerges as a logical one, to which the canons of the syllogism may be applied. Furthermore, a definition of this kind may sometimes inform an essay throughout its length, providing a basis for reasoned excursions into several interrelated phases of the general subject and inhibiting the use of ideas inharmonious with the central statement. This is one of the ways in which logic informs discursive prose.

A third among the methods of paragraph development is that of causes and effects or, as some authors prefer, "reasons and results." A recent handbook describes it as follows: "The purpose of

such a paragraph is to describe the forces that produce a situation."

This description encompasses a great many paragraphs. In fact, it is difficult to find a paragraph which does not in some degree fulfil its requirements. Depending upon the substratum of material events for their causal data, its authors provide no specifications concerning the paragraph itself; and so any paragraph will do.

Other authors restrict their discussions to matters of language. For example, in one book the entire section devoted to the methods of paragraph development is prefaced by the remark that "the nature of the topic sentence will normally determine how the remainder of the paragraph is developed." If this be true, the topic sentence or idea of any paragraph must in some overt way betray its structural tendencies. In other words, the form of the topic idea must determine, or be determined by, the structure of the paragraph as a whole. Perhaps it would be better to say that the paragraph, both topic and development, seed and shell, express a form; that they have a single principle of internal relevance.

So conceived, the causal paragraph presents difficulties to those who would define it. At any rate, the books which attempt definition achieve little success. Paragraphs quoted as examples, also, display a wide variety of characteristics. No definition which included all of them could be of great practical service.

To define causation itself is hardly an appropriate undertaking for a handbook in composition, but it is not unreasonable to suppose that some form of expression germane to the idea of cause might be devised. One solution would be to use the standard form of conditional statement as a paradigm: "If X, then Y." Even though the two-pointed vector in which modern logicians delight ("if and only if") may seldom suggest itself to writers, yet the modest "if . . . then" has its uses.

Teaching cause and effect in the hope of clarifying the paragraph may be fundamentally wrong. The confusing treatment which handbooks provide implies as much. But, if it is taught, it may be taught better by reference to a distinctive logical formulation than otherwise.

A fourth method of development, the last that requires discussion here, is that of comparison and contrast. Definitions of it usually employ the terms "likeness" and "difference."

> A topic may be made clear and effective by the use of *comparison* or *contrast*. The former shows the likeness between the topic and some concept or object familiar to the reader; the latter shows differences.

Or,

> The purpose of such a paragraph is to discuss the similarities or differences between two ideas or things.

Some of the books, including the two which have just been quoted, tacitly incorporate analogy with comparison; others regard analogy as a separate method; one book recommends analogy and omits comparison. Another author assumes that both likenesses and differences usually appear between any two objects or ideas which may be compared and presents three formulas for arranging details generated by comparative analysis.

Paragraphs quoted by way of illustration of comparison and contrast are remarkably rich and varied. Often several illustrative paragraphs are included under this heading, although each of the other methods be given but one. As the paragraphs are usually taught, classroom explanations gravitate toward theories of metaphor, of legal and semantic fictions, of the abstract and concrete in diction, of the familiar and the strange, or of something resembling Mill's methods of experimental inquiry. The potential range of the discussion is enormous, but it is doubtful that every student of handbooks is aware of its full extent.

Discrimination is not one of the salient characteristics of this aspect of instruc-

tion in English. In fact, narrow criticism of any of the methods of paragraph development, or of all of them together, encounters a denial that the enumerations of methods are intended to be systematic or exhaustive. All the handbooks agree that these are only "a few of the ways" and that "a dozen other ways" spring at once to mind. The customary prefatory remark is to the effect that "*some* methods of development are illustrated below."

But, in spite of this insistence upon the casual and random nature of the listings, the listings are almost universally the same. Is it not strange that so many grabs into the barrel should meet with identical luck?

To mention the methods of paragraph development is to accept some degree of responsibility for a methodical treatment of them. Denial of this responsibility does not remove it. By a similar casualness the introduction to an elementary grammar might be made to read "some of the parts of speech are defined and illustrated below." It is true that the author is saved a great deal of bother (so much, in fact, that he need never have bothered at all), but, if teachers undertake to introduce problems of relevance implicit in the paragraph, they also should be able to place them within a discipline as well ordered as that of basic grammar.

Sometimes the observation is made that good writing is extraneous to any discipine whatever. Spelling, punctuation, manuscript preparation, and grammar are disciplines, and they have been conscientiously taught in many colleges. Yet the performance of students on objective examinations designed to test these proficiencies has no significant correlation with what is called the "ability to write." Swayed by this exasperating fact, teachers sometimes adopt a special kind of cynicism based upon ineffables such as taste, instinct, and intuition, and they decline to discuss the matter further.

The difficulty is one which frequently arises elsewhere in educational theory and practice. It stems from a distinction between technique and improvisation. The distinction is prompted by the common experience of life as well as by educational historians and appears outside as well as within those portions of society formally identified with academic institutions. It pervades the general policies of schools and assumes its endemic form in each department and course.

Insofar as a generic, universal definition of technique is possible, it may be associated with the idea of repetition. Technique in music is the result of doing certain things over and over again until their execution becomes automatic. Technique comes from drill, practice, memorization, copying, tracing, paraphrasing, reciting. It is essentially mechanical. The technician assumes fixed and recurrent sets of circumstances in which proved sets of actions have fixed and recurrent appropriateness. The "minimum essentials" of writing are, in this sense, its technique. Logic is a technique of thinking, and the logician presumably goes through the same procedures every time he thinks.

On the other hand, improvisation belongs to singularity. Its actions are unique. It arises from spontaneity, freedom, vigor, imaginativeness. It yields freshness, novelty, originality. In music it is the result of genius. It is essentially vital. Its grammar is creative form and its logic, insight. The spirit of adventure which invests it is often identified with life itself, and the teacher who suppresses or inhibits it is an abomination in all eyes.

One of the peculiarities of this distinction is its extraordinarily forceful divisiveness. Values cluster about both terms. Admiration for the values of one seems to invite contempt for those of the other. Although it is difficult to imagine an action which is purely either technical or impromptu, one often hears real actions described in terms of one extreme or the

other. The very same event, if it have the misfortune to offend, may be doomed at one moment as a product of dull automatism and at another as bohemian irregularity. The distinction has been a rich source of polemical language.

Stated in general terms, the differentiation of discipline and spontaneity paralyzes decision and leads practical arguments into confusions from which they cannot escape. Stated in terms of a particular context, the distinction is more manageable. For example, improvisation in music cannot be made intelligible by virtue of discipline in abstract; it requires the appropriate disciplines, those of form, rhythm, and tone. Free improvisation in spelling cannot be regularized by finger exercises at the piano. The relationships between two sentences cannot be systematically accounted for by reference to their internal grammar. Technique and improvisation cease their warfare when confronted by a single problem.

Teachers who use the précis as a device of instruction often regard it as a means for studying the interrelationships of sentences. A good précis retains in small the proportions and relationships of its original. But it would be unfair to assume that a student can accurately paraphrase and condense a reasoned essay by sheer imaginativeness. In fact, few teachers expect him to. As it is frequently written, the précis is an attempt at grammatical representation of logical phenomena. Students ask of an essay, "What does it mean?" The answer is to be regarded as perfect when grammatical subordination and co-ordination have in some fashion been made to conform with the supposed emphases and equations of the original. But essays, and even paragraphs, do not necessarily fit into a grammatical matrix. The receptacle may prove inadequate.

Notions of a universal method of English composition or of thought are both objectionable and absurd. Closed methodologies are properties of closed minds. But method is not necessarily tyrannical. The pliability and expansiveness of the grammatical sentence springs from a discipline in which every responsible teacher of composition expects a degree of technical precision. None would claim even for himself a mastery of every possible aspect and incident of grammar; yet all are glad to initiate students into the science.

Traditionally the sentence is the fundamental unit of the composition course. But teachers are aware that this unit is environed in disciplines of different kinds. One adjacent area is that of semantics. Another is that of logic. Lifted from its grammatical context, the word raises new questions of its own. In a similar fashion the relationships among sentences raise questions which grammar cannot answer.

It is oversimplification to represent these three different orders of questions as genuinely separate, as though they appeared in isolation from one another. Logical, grammatical, and semantic problems are related parts of the problem of composition, just as composition itself is in many of its aspects a mode of thought.

With regard to logic, grammarians are drawn to it by difficulties which appear within the sentence but which can be resolved only by reference beyond the sentence. The interrelationships of sentences affect the forms of sentences themselves. Grammar and logic become enmeshed in the effort to find *this* expression of *this* idea.

For the problems of composition are ever renewed. They are as formidable for the seasoned scholar as for the undergraduate. The man who declares that he has "learned to write" must surely mean only that he has learned to say certain things and that he foresees no need for saying anything else. Composition, in the full sense of the word, can be neither learned nor taught. There can be no greater insolence than to suppose one's self prepared for the unknown.

But in a humbler sense the teaching of composition is not beyond hope. The conflicts, encounters, and discoveries of young college students are less inaccessible than the outer universe. The ideas with which they struggle are not only known; they are for the most part prescribed by the vote of the faculty. It is only a minor cosmos. Students live within it in spite of themselves. Teachers are well advised who learn to live within it, too. Certainly the teacher who wishes to assist his students in the moments of arrest, consolidation, and clarification, which at best their writing provides for them, will need the terms of logic. And it is to be hoped that he will use them, not as rigid, antiquated formulas, but with the flexible inventiveness of professional understanding.

A CASE STUDY IN SCIENTIFIC INQUIRY: ATMOSPHERIC PRESSURE, INCLUDING BALIANI'S IGNORED LETTER

Malcolm Correll

MANY educators who are concerned with natural sciences in general education recognize a young but important objective for science courses at the general education level. They believe that these courses should strive to impart to their students not only knowledge about the natural world but also some appreciation of those processes of inquiry whereby such knowledge comes into being. The espousal of this latter objective in any very serious sense was rare fifteen years ago; but today the thoughtful observer is increasingly impressed with the layman's need, as citizen, government official, or businessman, to understand not only some of the fundamental *works* of science but also something of the nature of the *workings* of science.

It should not be hard, then, for the science teacher with an idea to assemble a group of colleagues who subscribe to this aim in principle. Most of them, however, would feel that the implementation of the goal is fraught with difficulties. Indeed, in relation to several noteworthy curriculums, where courses conscientiously attempt to instil some knowledge of science as a mode of inquiry, the consensus concerning basic pedagogic problems is anything but overwhelming. And some people, though professing sympathy for the objective, feel that, desirable or not, it concerns matters too subtle for the general student and, realistically, should be abandoned at his level.

One obstacle, and the source of much disagreement about the pedagogics of acquainting students with the nature of scientific inquiry, lies in the inaccessibility of suitable materials by means of which significant investigations may be examined. The reason that these materials are so unavailable springs from the fact that, for centuries now, the teaching of science has concerned itself almost exclusively with the deductive aspects of science, wherein the great generalizations are asserted, after which their pertinencies as descriptions of nature and their practical applications are examined. Our courses have shown little or no interest in the inductive aspects of science through which the great generalizations emerge. Thus, for example, the study of dynamics is initiated with the assertion of Newton's laws rather than with Galileo's inductive discovery of Newton's first law, although in this particular instance some of the appropriate work of Galileo is quite available.

It is, however, the work *leading to* the great generalizations—laws, theories, or what you will—that is the lifeblood of science, that is the pace-setter for the engineering arts, and that pushes at our cultural frontiers. And, although the writings of the original investigators have become rare through neglect, they are available from the larger and older libraries. Much good work of searching, translating, editing, and recasting some

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of these cultural treasures is now in progress. We may hope in time, then, to adapt some of these materials for showing how scientific knowledge is acquired. In the meantime, we may seek out and put to trial any historic instance of investigation which may aid in acquainting the student with some aspect of the nature of inquiry.

The original publications that comprise the sources of our knowledge about atmospheric pressure are, for the most part, quite accessible. Therefore, adaptations of them for the study of the nature of scientific inquiry may be made fairly readily. Moreover, these papers as a group are rewarding, when considered from the standpoint of the investigatory aspects which they display.

In what follows I survey briefly the pertinent writings of Galileo, Torricelli, and Pascal so as to be prepared finally to show what these investigations can reveal about the nature of scientific inquiry. I also want to introduce a little-known, but highly germane, letter from Baliani to Galileo. This letter, as will be seen, bears a very curious relation to the work of Galileo and of Torricelli, and I want to deal with this phase of the study in detail.

GALILEO AND NATURE'S ABHORRENCE OF A VACUUM

Galileo's contribution to the understanding of atmospheric pressure centers around the frequently quoted passage dealing with the suction pump. Unfortunately, the quotations are usually so emasculated and so divorced from their original context that from them one cannot glean much of Galileo's perspective for the pump phenomenon. It is desirable here, then, to give a rather complete account of the context into which Galileo wove his observations on the suction pump.

The usual Galilean source of the pump phenomenon is the well-known *Two New Sciences.*[1] Galileo there writes on a variety of subjects, his ideas and arguments being expressed in the form of a discussion between the dialogists—Salviati, Sagredo, and Simplicio. In treating of the resistance which solid bodies offer to fracture, Galileo causes Salviati to say:

> . . . you are waiting to hear what I think about the breaking strength of other materials which, unlike ropes and most woods, do not show a filamentous structure. The coherence of these bodies is, in my estimation, produced by other causes which may be grouped under two heads. One is that much-talked-of repugnance which nature exhibits towards a vacuum; but this horror of a vacuum not being sufficient, it is necessary to introduce another cause in the form of a gluey or viscous substance which binds firmly together the component parts of the body.
>
> First I shall speak of the vacuum, demonstrating by definite experiment the quality and quantity of its force. . . .[2]

Salviati continues by describing the coherence of highly polished plane plates, noting that, when they are placed in contact, the upper will support the lower indefinitely and that, since they will slide over each other with ease, viscous attachment must be absent. This phenomenon he attributes to nature's abhorrence of a vacuum. He further observes that, even with unpolished plates, there is resistance to a sudden separation of them. Salviati concludes by saying, "This resistance which is exhibited between the two plates is doubtless likewise present between the parts of a solid, and enters at least in part, as a concomitant cause of their coherence."

For a "definite experiment" to demonstrate the quality and quantity of the force of the vacuum, Galileo chooses "a

[1] Galileo Galilei, *Dialogues Concerning Two New Sciences,* trans. Henry Crew and Alfonso de Salvio (New York: Macmillan Co., 1914; reissued in 1933 by Macmillan, and in 1939 and 1946 by Northwestern University, Evanston and Chicago).

[2] *Ibid.*, the dialogues of the "First Day," pp. 10–11. Reference here is to the 1946 edition.

continuous substance whose parts lack all resistance to separation except that derived from a vacuum, such as is the case with water." The apparatus consists essentially of a hollow cylinder, mounted so that its axis stands vertically, and plugged at the upper end, so as to be airtight. The inner walls of the cylinder are very smooth, and a well-fitted piston closes the lower end. To the lower side of the piston is attached a vessel into which sand may be poured as a load to pull down the piston. Now in order to measure the resistance to separation which arises from the vacuum alone, Galileo completely fills the space within the cylinder with water.[3] He next slowly loads the piston by pouring sand into the vessel. When a separation finally occurs between the water and the cylinder end, the weight of the piston, the water, and the vessel and its contents will equal the "force of the vacuum." Galileo extends this discussion to note:

> If one attaches to a cylinder of marble or glass a weight which, together with the weight of the marble or glass itself, is just equal to the sum of the weights before mentioned, and if breaking occurs, we shall then be justified in saying that the vacuum alone holds the parts of the marble and glass together; but if this weight does not suffice and if breaking occurs only after adding, say, four times this weight, we shall then be compelled to say that the vacuum furnishes only one-fifth of the total resistance.

At essentially this point in the discussion Galileo has Sagredo recount the pump experience. Sagredo says:

> Thanks to this discussion, I have learned the cause of a certain effect which I have long wondered at and despaired of understanding. I once saw a cistern which had been provided with a pump under the mistaken impression that the water might thus be drawn with less effort or in greater quantity than by means of the ordinary bucket. The stock of the pump carried its sucker and valve in the upper part so that the water was lifted by attraction and not by a push as is the case with pumps in which the sucker is placed lower down. This pump worked perfectly so long as the water in the cistern stood above a certain level; but below this level the pump failed to work. When I first noticed this phenomenon I thought the machine was out of order; but the workmen whom I called in to repair it told me the defect was not in the pump but in the water, which had fallen too low to be raised through such a height; and he added that it was not possible, either by a pump or by any other machine working on the principle of attraction, to lift water a hair's breadth above eighteen cubits; whether the pump be large or small this is the extreme limit of the lift. Up to this time I had been so thoughtless that, although I knew a rope, or rod of wood, or of iron, if sufficiently long, would break by its own weight when held by the upper end, it never occurred to me that the same thing would happen, only much more easily, to a column of water. And really is not that thing which is attracted in the pump a column of water attached at the upper end and stretched more and more until finally a point is reached where it breaks, like a rope, on account of its excessive weight?[4]

Salviati, Galileo's obvious mouthpiece, agrees unqualifiedly with Sagredo's interpretation of the pump phenomenon and notes that eighteen cubits is the maximum length for a column of water in a suction pump, whether the pump be "large or small or even as fine as a straw." And he adds that, "on weighing the water contained in a tube eighteen cubits long, no matter what the diameter, we shall obtain the value of *resistance of the vacuum* in a cylinder of any solid material having a bore of this same diameter."[5]

Galileo concludes this immediate phase of the discussions by observing that there is a critical length for any material, having not only the "force of the vacuum" but also the other cause or causes of

[3] *Ibid.*, p. 14. Galileo describes a provision in the apparatus for the introduction of the water and also a way to check to see that no air has accidentally remained within. These details need not concern us here.

[4] *Ibid.*, p. 16.

[5] Italics added.

coherence. Thus, if the material be shaped into a cylindrical rod and suspended so as to hang vertically from its upper end, there is a critical length beyond which this rod cannot be lengthened, since it will break under its own weight. And, while this length will be different for different materials, it will be independent of the cross-section of the rod.

This, then, is the perspective by which Galileo viewed suction pumps. We shall see that he apparently deliberately preferred this view to the modern one.

TORRICELLI AND THE OCEAN OF AIR

We find the modern notion of atmospheric pressure almost completely unfolded in Torricelli's letter to Michelangelo Ricci. The letter bears the heading, "Florence, June 11, 1644." It is to be compared subsequently with Baliani's letter to Galileo, which was written nearly fourteen years earlier. Torricelli says in part:

I have already intimated to you that a certain physical experiment was being performed on the vacuum; not simply to produce a vacuum, but to make an instrument which would show the changes in the air, which is at times heavier and thicker and at times lighter and more rarefied. Many have said that a vacuum cannot be produced, others that it can be produced, but with repugnance on the part of Nature and with difficulty; so far, I know of no one who has said that it can be produced without effort and without resistance on the part of Nature. I reasoned in this way: if I were to find a plainly apparent cause for the resistance which is felt when one needs to produce a vacuum, it seems to me that it would be vain to try to attribute that action, which patently derives from some other cause, to the vacuum; indeed, I find that by making certain very easy calculations, the cause I have proposed (which is the weight of the air) should in itself have a greater effect than it does in the attempt to produce a vacuum. I say this because some Philosopher, seeing that he could not avoid the admission that the weight of the air causes the resistance which is felt in producing a vacuum, did not say that he admitted the effect of the weight of the air, but persisted in asserting that Nature also contributes at least to the abhorrence of a vacuum. We live submerged at the bottom of an ocean of the element air, which by unquestioned experiments is known to have weight, and so much, indeed, that near the surface of the earth where it is most dense, it weighs about the four-hundredth part of the weight of water.[6] Those who have written about twilight, moreover, have observed that the vaporous and visible air rises above us about fifty or fifty-four miles; I do not, however, believe its height is as great as this, since if it were, I could show that the vacuum would have to offer much greater resistance than it does—even though there is in their favor the argument that the weight referred to by Galileo applies to the air in very low places where men and animals live, whereas that on the tops of high mountains begins to be distinctly rare and of much less weight than the four-hundredth part of the weight of water.[7]

Torricelli then goes on to describe the now well-known barometer experiment. He explains that he proved that the space at the top of the tube was perfectly empty by covering the mercury in the open dish with a layer of water; then, as the mouth of the mercurial tube was slowly raised above the mercury-water interface, the mercury fell from the tube to the bottom of the dish, ". . . whereupon with a violent impetus the

[6] Torricelli undoubtedly refers to the experiments of Galileo. In *Two New Sciences*, pp. 76–77, Galileo describes two methods whereby he can measure "the weight of air as compared with that of water." He reports that air is about one four-hundredth as dense as water, a little less than twice the value found by modern measurements.

[7] The letter is published in Gino Loria and Giuseppi Vassura, *Opere di Evangelista Torricelli* (Faenza, 1919), III, 186 ff. The excerpt given here is from I. H. B. and A. G. H. Spiers, *The Physical Treatises of Pascal*, Appendix III, "Torricelli's Letters on the Pressure of the Atmosphere," translated from the text of Loria and Vassura by Vincenzo Cioffari (New York: Columbia University Press, 1937), p. 163.

tube was filled with water completely to the top."

In refuting the notion that it is the empty space which holds the mercury up in the tube, Torricelli says:

> On the surface of the liquid which is in the basin, there gravitates a mass of air fifty miles high; is it therefore to be wondered at if in the [mercurial tube], where mercury is not attracted nor indeed repelled, since there is nothing there, it enters and rises to such an extent as to come to equilibrium with the weight of this outside air which presses upon it?[8]

Torricelli continues his letter to Ricci by two further observations: that water will rise in a water barometer as much farther than mercury as mercury is heavier than water and that the height of the mercury column is independent of the volume of the empty space above it. He records that he had "tried to consider from this point of view all the kinds of repulsions which are felt in the various effects attributed to vacuum, and thus far [had] not encountered anything which does not go." Torricelli concludes by mentioning some disturbing temperature effects, "exactly as if the empty space were full of air." These effects, he says, prevented his using the instrument to determine when the air was heavier and thicker or lighter and more rarefied.

It remained, perhaps, to argue specifically that the lesser density of air in high places is attributable to the lesser depth and, consequently, to the lesser pressure of the atmospheric ocean above it, though this is strongly implied by Torricelli's letter. At any rate, later work by Pascal makes this very obvious.

PASCAL'S CONTRIBUTIONS

Pascal first learned of Torricelli's experiments through Father Marin Mersenne; so says an account presumably written by Florin Perier, Pascal's brother-in-law. Thereupon, Pascal repeated Torricelli's experiments in all details and conducted a variety of ingenious new experiments concerning "the vacuum." Accounts of eight of these experiments appeared in 1647 in a pamphlet entitled *Expériences nouvelles touchant le vide.*[9] Since others were conducting investigations on the same general problem, Pascal threw *Expériences nouvelles* together in haste. It was published in outline form and is frequently referred to as *L'Abrégé.* Pascal's promise to expand the outline into a treatise was apparently never fulfilled.

An English translation of *L'Abrégé* has not been published, and one would be too long to include entirely within this paper. But, since the work represented by *L'Abrégé,* from the standpoint of inquiry, was indispensable to the final burial of abhorrence notions, I shall characterize its contents. The eight experiments of *L'Abrégé* are designed, first of all, to examine the nature of what Pascal calls the "apparent void." Without going into detail we may place these experiments in four groups according to purpose.

1. Using a syringe, and subsequently a bellows, Pascal showed that nature's inclination to fill an apparent void was independent of the size of the void. This he did by thrusting the syringe piston all the way in and then stoppering the opening so that his finger rested against the bottom of the piston, the internal volume of the syringe in this state being zero. He then pulled back the piston and noted that the pull on his finger and the pain he experienced was independent of the size of the apparent void.

2. Using "barometer tubes" — i.e., straight tubes open at one end and

[8] *Ibid.,* p. 165.

[9] See Fortunat Strowski, *Pascal: Édition définitive des œuvres complètes.* Vol. I: *Biographie et œuvres scientifiques* (Paris, 1921–31), p. 11. A rather full description of the contents of the pamphlet, with commentary, may be found in Isabel Leavenworth, *A Methodological Analysis of the Physics of Pascal* (New York: Institute of French Studies, 1930).

hermetically sealed at the other; syringes; and scalene siphons of various appropriate lengths—e.g., one siphon had legs of 50 and 45 feet—Pascal showed that, whenever the apparent void was established at the top of one of these devices, the liquid column (water, mercury, or red wine) stood at a height inversely proportional to the density of the liquid being employed; that the *height* of the column was independent of the inclination of the device but that the apparent void became smaller as the inclination became greater; that the height of each liquid column was equivalent to about 31 *pieds* of water; that the apparent void could be made to vanish by a sufficiently great inclination; and that a siphon of sufficient length could be turned on or off by inclining it so that the apparent void vanished or by raising it so that the void was re-established.

3. A barometer tube and a siphon were filled as completely as possible by rope, water-soaked so as to exclude all air, and all other internal space was filled with water. These devices were then mounted in the usual fashion with their open ends in dishes of mercury. Then, as the rope was withdrawn from the tubes, mercury rose therein to fill the resulting space. When, however, the mercury column plus its overlying water column were equivalent to "deux pieds trois pouces" of mercury, the apparent void appeared. After the rope was completely withdrawn, the siphon could be made to operate by inclining it as in the other experiments.

4. One experiment attempted to show that a mercury syringe weighed no more when the apparent void was large than when it was small. Pascal apparently wished to show that no matter having weight occupied the apparent void. *L'Abrégé* gives no data and makes no mention of the accuracy of the weights, nor does it discuss a buoyancy correction necessitated by the fact that the internal volume of the syringe displaces more atmospheric air when the piston is drawn far out. For further discussion of this experiment see the commentary of Leavenworth.[10]

From these experiments Pascal drew some conclusions, which we might regard as laws of the *apparent void.* These conclusions appear in *L'Abrégé* as a list of seven maxims, and essentially they simply summarize the results of his experiments.

L'Abrégé continues with eight propositions without proof, which, if they had been proved as promised for the treatise that was to follow, would have shown that the apparent void is *truly* void. These propositions follow:

1. That the apparent void is not filled with the outside air which surrounds the tube, and which has entered through the pores of the glass.
2. That it is not full of the air which some philosophers say is confined in the pores of all bodies, which is present in this manner within the liquid that fills the tubes.
3. That it is not full of the air that some deem to be between the tube and the liquid which fills it, and confined in the interstices or atoms of the corpuscles which constitute the liquids.
4. That it is not full of an imperceptible grain of air, left by chance between the liquid and the glass, or carried by the finger which stoppers [the tube], or admitted in any other fashion, which becomes extraordinarily rarefied, and which some maintain could be rarefied enough to fill the whole world, rather than to admit a void.
5. That it is not full of a small portion of mercury or of water, which, being attracted on one side by the walls of the glass, and one the other by the force of the liquid, becomes rarefied and converted to vapors; so that these opposed attractions may produce the same effect as heat which converts these liquids to vapor, and makes them volatile.
6. That it is not full of the spirits of the liquid, which fills the tube.
7. That it is not full of a more subtle air mixed with the outside air, which being separated from it and entering through the pores of the glass, tends always to return to

[10] *Op. cit.*, p. 54.

[the outside jar] or be always attracted by it.

8. That the apparent void is not filled with any materials that are known in nature, and which affect any of the senses.

From these propositions Pascal concludes that the apparent void is truly void, and all the conclusions concerning the former are restated for the latter. He ends *L'Abrégé* with a list of five objections to the existence of voids, and he promises to respond to them in the treatise. The objections, briefly stated, are that voids are against common sense; that abhorrence of a void and existence of a void imply contradiction; that several phenomena show that nature will not permit a void; that an unknown and imperceptible matter fills the space; and that light is either wave or matter and that, as a wave, it could not pervade a void or, as matter, it would fill the void. It should be noted that *L'Abrégé* contains no statements conceived in terms of pressures; the consideration throughout is in terms of voids.

The rest of Pascal's work pertaining to the present topic is so well known and so readily available in English that it need be discussed only briefly. In 1648 Pascal published *Récit de la grande expérience de l'équilibre des liqueurs.*[11] This is the famous experiment carried out by Perier for Pascal. It involved a number of carefully controlled barometric measurements at various altitudes along the slopes of the Puy-de-Dôme, a mountain in Auvergne. This experiment was by way of being an *experimentum crucis,* since it established beyond doubt that atmospheric pressure varies with altitude, a prediction from the atmospheric-ocean hypothesis which had not yet been experimentally verified.

Two other treatises by Pascal, *Traité de l'équilibre des liqueurs,* and *Traité de la pesanteur de la masse de l'air*[12] serve a great synthesizing function. The first of these is an extensive treatise on hydrostatics. As such, this work unifies and enlarges the works of Archimedes and Stevin. The second treatise adopts three premises: (1) air has weight; (2) like water, air has fluidity; and (3) like handfuls of wool, air is compressible. It then virtually enlarges the hydrostatics to comprehend fluids in general and thereby embraces Torricelli's investigations with those of Archimedes and Stevin.

These, then, were Pascal's roles: a careful experimenter, who tested voids and pressures exhaustively, and a synthesizer, who merged the bits and pieces of pressure knowledge into a unified whole,[13] in much the same fashion that Newton, more spectacularly, wove contributions from Galileo, Wallis, Wren, Huygens, Hooke, Halley, and Kepler into Newtonian mechanics.

BALIANI'S LETTER TO GALILEO

The letter in which we are most interested is the third of three exchanged by Giovanni Battista Baliani and Galileo in 1630. Baliani wrote the first letter on July 27, 1630.[14] He had built a siphon of copper pipe, which was supposed to lift water over a rise some 70 feet high. He had met with failure, of course, when he attempted to set the siphon in operation, and in the letter he was seeking Galileo's help.

On August 6, 1630, Galileo wrote his reply.[15] In considerable detail he explained that, while water may be forced to any height by pressure, it can be lifted only "about 40 feet, maybe even less," by suction. He then said: "The reason for this result bothered me a great deal prior to my research; finally it occurred to

[11] See Strowski, *op. cit.,* p. 50; for an English translation see Spiers and Spiers, *op. cit.,* p. 97.

[12] See Strowski, *op. cit.,* pp. 73 and 93, respectively. For an English translation see Spiers and Spiers, *op. cit.,* pp. 3 and 27, respectively.

[13] One hardly needs to apologize to Boyle here, for Pascal inferred Boyle's law and apparently made a *qualitative* test of the law (see Spiers and Spiers, *op. cit.,* pp. 30–32).

[14] *Le Opere di Galileo Galilei* (ed. naz.; Florence, 1900), XIV, 124, letter no. 2040.

[15] *Ibid.,* p. 127, letter no. 2043.

me that the reason cannot be so obscure, but rather plain, as always happens with a true reason after it has been found." He then set forth his notion that, just as hemp rope will break of its own weight if made sufficiently long and suspended from its upper end, so also will a "rope" of water break when its length exceeds a certain amount. We need not enlarge upon this here, since the conception is in all details like the one already discussed. Galileo did include for Baliani's special circumstance, however, the observation that the inclination of the siphon "does not help any . . . that the greater length of the incline causes it to be filled by more water and this in turn makes up for the greater resistance that would be encountered in a vertical pull."

Baliani wrote the third letter of the series on October 24, 1630.[16] I reproduce here a translation of the portion of the letter,[17] which anticipates Torricelli by fourteen years:

> . . . I failed to distinguish between raising water by suction in a siphon, or by pressure; and since we know from Vitruvio and Frontino that the Romans pushed water up very high, while using siphons to cross the valleys, which I guess were not so deep, I thought that the same job could be done with suction; and that, no matter whether the siphon would always operate so long as it was built so that not to operate would produce a vacuum. I realize my error, and that your remark is quite right, that a cable, even made of iron and regardless of size, cannot sustain too great a weight, not even itself when it gets too long and too heavy. Therefore, it will support itself only within definite limits, which you explain very well. I understand also why the same holds true for the water in the pipe. But I am sure that you will permit me to say that there remains a doubt in my mind. You mention that a rope of water will break more easily than a hempen cable, since the parts of the water in order to separate must overcome only the resistance of the vacuum, the magnitude of which has not been determined. And if the vacuum in some degree impedes the breakage of the rope, and so much more if the rope be made of iron, in each case it seems to me there must be a great deal of difference, whenever the rope breaks; indeed, it seems doubtful that there remains a vacuum. But whatever the case it is certain that the vacuum remaining in the pipe will be much greater.[18]
>
> I do not share the popular view that there can be no vacuum. But I find it hard to believe that the vacuum can be created in such quantities and so easily. . . . I have believed that a vacuum may exist naturally, ever since I learned that the air has sensible weight and since you taught me in one of your letters how to find its weight exactly, though I have not yet succeeded with that experiment. From that moment I adopted the notion that it is not repugnant to the nature of things that there should be a vacuum, but only that it is difficult to produce, and that it is not possible without a great deal of force; and that it must be possible to determine just how much force is needed to create a vacuum. To explain myself more clearly, if air has weight, there is no difference between air and water except in degree. It is better, therefore, to consider water, whose weight is more sensible, so that later the analogy may be applied to air.

[16] *Ibid.*, p. 157, letter no. 2075. The only English reference to this letter known to me is in J. E. Drinkwater-Bethune, *Life of Galileo: With Illustrations of the Advancement of Experimental Philosophy.* Drinkwater-Bethune's work may be found in the collections "Library of Useful Knowledge: Lives of Eminent Persons," published under the superintendence of the Society for the Diffusion of Useful Knowledge (London, 1833) and "The Republic of Letters: A Republication of Standard Literature," ed. Mrs. A. H. Nicholas, Vol. IV (New York, 1835). Page references in this article are to the former source.

Late in chap. xvii (p. 90), Drinkwater-Bethune presents a severely edited translation of the core of Baliani's letter.

[17] I am indebted for this translation to Professor Rudolph Trenton, of the Oklahoma Agricultural and Mechanical College.

[18] Baliani apparently means that, even though abhorrence of a vacuum accounts for the coherence, in whole or in part, of ropes of water, hemp, or iron, only in the case of water in too long a siphon does a vacuum really exist after breakage occurs.

I imagine myself to be on the bottom of the sea, where the water is 10,000 feet deep. And, if I did not have to breathe, I think I might remain there even though I should feel more pressure from all sides than I do now. Because of that pressure I believe that I could not possibly stay on the bottom of an unlimited depth of water as it grows larger and larger; it seems to me that the pressure must grow proportionately to the point where my body could no longer resist it. But to return—from that pressure on the outside I should not feel any trouble; I should feel the weight of the water no more than I do when I dive at a summer bath in the sea where I have 10 feet of water over my head without feeling the weight. But if I were not inside the water, which presses me from all sides, but in air—not to say in a vacuum—and if I had the water only above my head, then I should feel the weight, which I could not sustain unless I had strength proportionate to it. This means that, whenever we separate forcibly the upper parts of the water from the lower ones—even though no vacuum remains, but air flows in—in either case, it takes force to separate the two, not an infinite but a determinate force, which increases according to the depth of water under which I stand. No doubt on the bottom of 10,000 feet of water, as mentioned before, it would be impossible to separate the two masses with any amount of force, which makes it impossible to prove the point; and yet it is seen that it really is not impossible, but that the obstacle is only that he [*sic*] does not have enough strength [to separate the water].

It seems to me that the same thing happens to us in the air. We are on the bottom of its immense expansion; we feel neither its weight, nor the pressure which is on all parts of us, because our bodies have been created by God in such a manner that they can well stand this pressure without hurting —on the contrary, we need the air and could not do without it. But even if we did not have to breathe, I believe we could not stay in a vacuum. For if we were in a vacuum, we should feel the weight of the air above our heads, which I believe is very large. Even though I estimate the air to become lighter as we go up, I still believe that the total air is so immense that even where its specific gravity is little, we should still very greatly feel the weight of all that air which is still above us. But this weight is not infinite and therefore is determinable. It could be overcome by a force proportionate to it, thereby causing a vacuum. To find out this proportion we must know the height of the air and its weight at each level. In fact I estimate it to be such that, to cause a vacuum, I believe we require a force greater than that of a column of water 80 [*sic*] feet high.

I must apologize for being so long; if this theory is correct, I know you will have considered it before. If it contains a slip of logic, it will be enough for you to mention it briefly.

So wrote Baliani fourteen years before Torricelli initiated the studies which led to the validation of this hypothesis.

COMMENTARY ON BALIANI'S LETTER

Galileo evidently took no special notice of Baliani's letter. No response to it can be found in Galileo's collected correspondence, nor did Baliani write Galileo again for about two years. A main point of interest is: Why did Galileo, a man of unusually great acuity, reject and fail to develop a hypothesis which later proved to be so fruitful?

The date was 1630 and, according to Galileo's biographers,[19] he did not complete his manuscript for *Two New Sciences* until 1636, and publication did not occur until 1638 in Amsterdam. Yet *Two New Sciences* employs nature's abhorrence of a void in a strength-of-materials context exactly as Galileo had used it to explain to Baliani why the siphon did not function. Certainly, any suggestion that Baliani's notion came too late would seem to be rather implausible.

Furthermore, *Two New Sciences* has a distinctive character: it is steeped in hypotheses which are advanced and probed for their rejection or validation, though in many cases, even when the hypothesis receives tentative approval, no further use is made of it. In fact,

[19] See, e.g., J. J. Fahie, *Galileo: His Life and Work* (New York: James Pott & Co., 1903), p. 346.

Drinkwater-Bethune says: ". . . the reason which [Galileo] himself gave [for preferring the dialogistic form] is, the greater facility for introducing new matter and collateral inquiries, such as he seldom failed to add each time that he reperused his work."[20] It would have been quite in the spirit of *Two New Sciences* for Galileo to deal with Baliani's hypothesis.

And yet again, it would seem that Galileo might readily have welcomed Baliani's notion, since in *Two New Sciences* he expresses some dissatisfaction with abhorrence of a vacuum as a scientific principle. He has Sagredo say:

> But here another difficulty arises. While experiment convinces me of the correctness of this conclusion [that the resistance to separation of two plates is due to abhorrence of a vacuum], my mind is not entirely satisfied as to the cause to which this effect is to be attributed. For the separation of the plates precedes the formation of the vacuum which is produced as a consequence of this separation; and since it appears to me that, in the order of nature, the cause must precede the effect, even though it appears to follow in point of time, and since every positive effect must have a positive cause, I do not see how the adhesion of two plates and their resistance to separation—actual facts—can be referred to a vacuum as cause when this vacuum is yet to follow. According to the infallible maxim of the Philosopher, the non-existent can produce no effect.

This difficulty is responded to—and this seems to me to be quite significant—by Simplicio, who says:

> Seeing that you accept this axiom of Aristotle, I hardly think you will reject another excellent and reliable maxim of his, namely, Nature undertakes only that which happens without resistance; and in this saying, it appears to me, you will find the solution of your difficulty. Since nature abhors a vacuum, she prevents that from which a vacuum would follow as a necessary consequence. Thus it happens that nature prevents the separation of the two plates.[21]

The next comment is Sagredo's, where he says: "Now admitting that what Simplicio says is an adequate solution of my difficulty . . ." and then turns to other matters. Clearly, however, Baliani's hypothesis furnished a cause which, for Galileo, would always precede the effects that are of concern in this debate.

One other fact appears to me to be quite indicative of Galileo's uneasiness over abhorrence of a vacuum as a principle: Salviati, who throughout *Two New Sciences* comes up with the "right" answers, takes no part in the effect-precedes-cause discussion, just as though, perhaps, the "right" answer were not known in this case.

Before we leave Galileo's failure to notice Baliani's letter, we should perhaps note a few things about this period of Galileo's life. At the time of the letter in 1630, Galileo was sixty-six years old. His *Dialogue on the Two Principal Systems of the World* was published in 1632, although the manuscript had been completed in 1630. By late 1632 the Inquisition, precipitated by this publication, was under way, and he was actively questioned by it until midyear, 1633. Afterward, although he was under surveillance, he could return to his work. In 1634 the death of his daughter affected him severely, and his health began to fail. Total blindness set in late in 1637. Nevertheless, biographers agree that his scholarly activity remained prodigious to the end of his life in 1642. Drinkwater-Bethune reports: "After his abjuration, [Galileo] . . . employed himself till 1636 principally with his Dialogues on Motion, the last work of consequence that he published."[22] All these things considered, however, it would not seem likely that health, persecution, or senility had quite forced Galileo into a condition where he would overlook—or ignore—Baliani's hypothesis.

There are two possible inferences to be drawn from Galileo's inattention to

[20] *Op. cit.*, p. 88.

[21] *Op. cit.*, p. 12.

[22] *Op. cit.*, p. 76.

Baliani's idea; neither is conclusive on the basis of the evidence which I can present at this time. First, because of temporary indisposition or other preoccupation, Galileo may have failed to read the letter; it is my impression that such neglect is quite unlike Galileo. Second, he may have ignored the letter, quite wilfully, because of his prejudice for an intrenched theory; the notion of atmospheric pressure is incompatible with the vagueness of abhorrence of a vacuum, which, as a principle, turns out to be *the cause of both kinds of coherence* in his theory of breakage.[23]

One other observation in regard to Baliani's letter should be made: Torricelli joined Galileo in October, 1641, about three months before the latter's death. One may speculate that Torricelli himself came across Baliani's letter and was by it inspired to do the work he reported in his letter to Ricci.

PEDAGOGIC CONSIDERATIONS

The subject-matter or scientific-knowledge content of this set of investigations is obvious. It remains for me to indicate how the set might be used to reveal something of the nature of scientific investigation and to summarize what the set reveals about the workings of science.

Propaedeutic to the series would be an understanding of the abhorrence principle and its applications; this would be essentially the kind of considerations that occur in chapter ii of Pascal's *Treatise on the Weight of the Mass of the Air*.[24] Also one might wish to precede the set with something like the essential conclusions of Archimedes or Stevin on floating bodies, although the contents of Pascal's *Treatise on the Equilibrium of Liquids* could stand quite alone. But in the latter case the synthesizing character of Pascal's work might not be so obvious.

The student textual materials may take several forms—the papers themselves, edited recastings in the vein of "smoother translations," or rewriting with generalized commentary—each with its own particular advantages and disadvantages. The choice must, of course, be made by the instructor himself. With any choice, but particularly with recastings or with rewrites with commentary, one must be wary of the attitude of the materials. The attitude should be neither patronizing nor overly charitable but should strive throughout to be thoughtfully critical. And the same may be said of the attitudes of the instructor and the students. At each stage of the study the students should see what the investigator admitted as evidence, what he chose as premises, how he reasoned, and what he concluded. The effort should always be to see how well a theory can be defended, never to see merely how quickly it can be discarded. Only by such patient probing can the real weaknesses of poorer theories and the real strengths of better theories be brought into proper focus.

As a conclusion we may list some points relevant to the nature of inquiry, which may emerge from this case study:

1. Investigations seek solutions to problems or answers to questions. The problems posed at different times during the course of an extended inquiry will vary in kind and in generality. Thus, in the study described, a very early question is: Why does water rise in suction pumps, siphons, and the like? This is quite different from the much later question of Pascal: Do the surrounding bodies show more inclination to fill a large apparent vacuum than a small one?

2. Answers *to the same question* will differ considerably in character at different stages of an investigation. Thus, for the question: Why does water rise in suction pumps, siphons, etc.? the case we have discussed shows two answers. The first is the principle that nature abhors a vacuum; this is an animistic solution and gives no clue as to how nature prevents what she abhors. The sec-

[23] See substantially the whole of the "First Day" of *Two New Sciences*.

[24] Spiers and Spiers, *op. cit.*, p. 32.

ond answer attributes the rise of the water to atmospheric pressure; consequently, it is mechanistic, and, while it may therefore tell how nature prevents or at least delays the formation of a vacuum, interest in nature as the agent has been considerably thrust back.

3. A principle under stress stimulates new research. Abhorrence of a vacuum evidently worked to everyone's satisfaction for centuries, until sufficient notice was taken of the fact that a void could exist anyway. This shook scientific complacency, and new investigations began.

4. A well-intrenched theory, law, or principle will be vigorously defended. Witness the hypotheses for this purpose, implied by Pascal's eight propositions.

5. A new phenomenon necessitates a search for its laws. Thus, when the void, or the apparent void, was brought to notice, Torricelli and more especially Pascal studied its nature in detail with numerous experiments.

6. An *experimentum crucis* tends strongly to secure a hypothesis. Hence, if the effects under discussion are caused by the pressure of an ocean of ponderable air, then the effects should diminish as one rises within that ocean, so that there is less air to press from above. This, being tried and proved, strengthens the hypothesis.

I wish, of course, that I could expand the fourth point above to declare that Galileo ignored Baliani's letter because of a prejudice for a well-intrenched theory; however, the evidence, as I have indicated, is insufficient. Could I verify my suspicion, I would do so not to detract from Galileo, of course, but to demonstrate that scientists individually may sometimes not practice, even as scientists, that objectivity which collectively they display so well.

DO WE WANT "WORLD HISTORY"?

Ellsworth Faris, Jr.

THERE remains today disagreement about the content and organization of history courses, which are generally required in general education programs in our colleges. Discussion persists at meetings of professional associations and in the literature. The American Historical Association, for example, had sessions on the subject at its meetings in 1948, 1950, and 1951. This *Journal* has printed several articles on college-level history courses and methods employed in teaching them. The *Twentieth Yearbook* of the National Council for the Social Studies was devoted to such problems, though much of the book concerned primarily the high-school level. The profession is convinced of the need for a course besides United States history but is not agreed on what it ought to contain.

This paper does not deal with the entire question of organization and method. Many of these details are, in any event, best settled with reference to local resources, availability of instructional materials, and the like. But there is an important question which is often overlooked, about which some remarks may be worth while. That question is whether to have the course deal with European and Western history or to devote large portions of it to the history of China, India, the Moslem world, and so forth. The problem is not new,[1] but its existence is sometimes ignored by calling a course "world history" when it includes much less than the history of the whole world.[2] This may be employing the term *Weltgeschichte* as used by Ranke or perhaps an unconscious inheritance of the older parochial view which still thought of the history of Europe as virtually equivalent to the history of humanity. Whatever the reason for this usage, it does not help us to say one thing and mean another. In this paper the term "world history" means the history of all mankind, from China to Peru, while "occidental history" is used for the history of Europe and its derivative cultures in areas settled by Europeans since the sixteenth century. The view here is that occidental history is suitable for the freshman course but that world history is not.

One often hears that modern world conditions demand a broader outlook and that therefore the history course should include sections dealing with all the peoples of the earth.[3] In the age of the United Nations, the atom bomb, and the cold war, it is necessary for every citizen to have an understanding of peoples and cultures outside his own. With the United States directly involved in the affairs of every quarter of the globe, we must comprehend how these distant peoples think, act, and make a living. And so, it is argued, the history course ought to reflect this present need and should devote some time to these once-remote regions.

To the first statement, no objection can be offered. We do indeed require citi-

[1] Cf., among many other examples, J. M. Gambril, "The New World History," *Historical Outlook*, XVIII (1927), 265–67; D. C. Babcock, "A New Social Function for History," *Historical Outlook*, XXI (1930), 16–19; and J. T. Horton, "Historismus for the Undergraduate," *Journal of General Education*, II (1947), 27–34.

[2] Cf. G. Bruun and G. Smith, "World History: The Problem of Content," *Social Education*, II (1947), 3–7, 53–57, 60.

[3] S. H. Zebel, "Basic Issues and Problems of the Freshman History Course," *Social Education*, XV (1951), 381–84.

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zens who are informed—they can never be sufficiently informed. But there is legitimate doubt whether this knowledge is best imparted through the freshman history course. For one thing, the available reading matter is usually less than satisfactory. There have been a number of books written with this general plan in mind. One well-known example, written for popular use, was produced at a time much like our own: H. G. Wells's *Outline of History*, first published in 1920. In the Introduction, the author said that *"there can be no common peace and prosperity without common historical ideas."*[4] He spoke of the unity of all history and hoped for a history of mankind. Wells was not a professional historian, and his book drew a considerable amount of criticism on technical grounds, but his fundamental idea—the essential unity of the entire human past—is still with us. It is found in many recent books, including, for example, one by Thorndike,[5] and it is the concept behind the recently announced history of mankind headed by Ralph Turner under United Nations auspices. Whether or not this latter project will be a success we cannot yet tell.

Books and courses of this type, presenting world history, provide the instructor with many difficulties and problems which are not easy to solve. Sometimes, as in the case of Wells's book, they are inaccurate and slanted in a certain direction, giving the student a misleading impression of events and trends. No history is written without some measure of "interpretation," but the amount of bias in such books is frequently too great for satisfactory use in a beginners' course. The other main difficulty is that texts of this sort have to be organized in a fashion which is confusing and bewildering to the reader. A chapter on the German invasions of the Roman Empire may be followed by one on early India; the book then skips to China, returns to the Byzantine Empire, the Moslem world, finally arriving back in medieval Europe—by which time the student has forgotten how he began this grand tour and has lost the continuity between Rome and the early Christian West. Some such skipping about is inevitable in a book covering so much material, but this seems excessive. Moreover, experience with this kind of text suggests that young students lose sight of the central theme of development, being so often diverted from its main course. Pedagogically, such an organization often proves a hindrance, not a help, to the instructor.

Still more important objections to this type of course plan arise from a consideration of the purpose of the history course and the nature of history as a discipline. Although there can be no authoritative statement of the objectives of such courses, it will be found, upon examining the literature, that those who have given their attention to the matter are in substantial agreement, though each writer expresses himself in a slightly different way. We may say that the defense of the history course usually includes the following arguments.

First, history offers valuable intellectual training in the criticism of source materials and the careful analysis of documents. These techniques of the historian may be applied by the student to other types of material, and he is thereby able to read and discuss more intelligently. Second, history furnishes data for the various fields of the social sciences and provides a check against the generalizations of social scientists by offering concrete examples on which abstract statements are tested. A student who knows something of economic history should have a better understanding of economic processes and problems. Third, history should help to dispel in the student the "nonsense of the wigwam," that ethnocentrism (and *chrono*-centrism) which is rightly regarded as a handicap for the understanding of pres-

[4] H. G. Wells, *The Outline of History* (New York, 1929), p. vi (italics in original).

[5] L. Thorndike, *A Short History of Civilization* (2d ed.; New York, 1948).

ent-day problems. A person who knows the "nine and sixty ways of constructing tribal lays," and that "every single one of them is right," is better for it, even though he knows that, for him, his own way is still the best. There is much to be said for the sophistication gained by this wider familiarity with men and their ways.

Now these three skills and understandings are worth while, and it should not be hard to agree that a properly conducted history course may do much to promote them. They are valid reasons for studying history as a part of general education. But we must not insist that history is the sole means of accomplishing these objectives, for most of the other disciplines in the humanities and social sciences can aid us materially. Nearly everyone, for example, believes that his own field provides excellent intellectual training (and offers himself as proof of the point), and history assuredly has no monopoly of that function. And if we are studying history simply in order to learn the principles of sociology, then we should turn the course over to the sociologists; they know their principles better than do the historians. These are satisfactory reasons for studying history, but they are not enough, nor are they peculiar to it as a discipline. Admittedly, if these are the only reasons we have, then the more ground we cover, the better job we can do. We could even abandon the chronological for an analytical organization of the course and then cease to call it history at all.

But there are other reasons for requiring the study of history which are more closely related to its essential nature. Each of us is the creature not only of a biological, but also of a social, complex. And this social complex is not static, it does not simply exist in the present but is the outcome of a long and very intricate process. Indeed, we can best think of our social milieu as itself a process, and our understanding of it must take account of this dynamic quality. For the individual to orient himself successfully in his social world, he must know this world not simply as it appears for the moment, but in its growth and change. And to know it in all its three dimensions is to understand better one's own role and position in time and space. "Every man of us has all the centuries in him," said Lord Morley; and, if we are to know ourselves, we must know something of these centuries. History is the record of the past experience of a people, and our beliefs and faiths rest ultimately upon our interpretation of this experience. We may think of the heritage of the past as a moral obligation (as did Burke) or as an onerous burden (as do some neoliberals), but it is with us and in us, no matter what we do. Many great moral and spiritual forces of our time are hardly to be dealt with at all without some understanding of their origins, growth, and modification. History initiates "young persons into the great traditions of the race . . . and [creates] in them an awareness of how those traditions operate in modern society."[6] But this can only mean our own tradition; Dante and Copernicus are of far greater importance for the modern American who is our student than is Confucius or Asoka.

The main objective of the history course is, then, the orientation and self-understanding of the student as a member of our culture, our tradition, with our creeds and faiths. This is the one aim of history which is peculiar to it, and it is one which seems better accomplished through history than through the other branches of the study of man. And it is fundamentally a moral aim.

Certain consequences follow from this concept of history. If history is at bottom a humanistic study, it partakes of the nature of the arts, and one of its most important features must be its unity

[6] Horton, *op. cit.*, p. 30.

of structure. The history of the Occident is such a unity, as is the history of the Orient or of Moslem civilization. We can write or study the history of the United States, of the South, or of the state of Georgia—each of them is a meaningful unit. But can we accept the "History of Wyoming, Delaware, and Florida"? The idea is absurd, because they do not form any logical unity; there is no single image with which we can deal. The history of England is a unit, but what of the history of Czechoslovakia? The term has meaning as a unity only since 1919; before that date we must deal with parts of the history of Bohemia, Austria, Hungary, Poland, and so forth. Czechoslovakia has been a unit for only a short time; "Czechoslovakia" has therefore only a short history.

We may apply the same reasoning to world history. The concept "world" has meaning only as a geographical or geological term until about the nineteenth century. As far as intersocietal relationships are concerned, there was no single "world" to be studied until recent times. World history breaks up into the histories of separate civilizations or regions, on the whole independent, and not forming part of the same continuous narrative. There is really nothing new or startling in this idea; Spengler, Toynbee, and many others before them have made the same point with varying degrees of clarity.

It may be objected that this view ignores the contacts between cultures in the past and that it implies an exaggerated degree of isolation of past civilizations. But to discuss contacts—between the Occident and the Moslem world in the Middle Ages, for instance—is one thing, and to try to make both cultures part of the same central narrative theme is something else. There should undoubtedly be study of such contacts and reciprocal influences—probably more than there is at present. But, though we discuss, in a biography, the influences on the character and actions of the protagonist, we still keep him in the center of the stage. A biography of Frederick the Great which discusses his father's shocking treatment of him as a young boy is still a biography of Frederick, not of the two men. Similarly, the contacts between Arab and "Frank" in the twelfth century are important to us because they help us to understand our own ancestors; but those ancestors are still the real center of interest. It should be possible to write world history for recent times, and the freshman course should by no means ignore events in Asia and Africa in the nineteenth century, for one cannot understand occidental history without knowing something of imperialism and the oriental reaction to it. Since the middle of the nineteenth century we have had a highly interrelated world with which we can deal, and to omit the role of non-Western civilizations in the last hundred years would be highly misleading. But to speak of world history in our own time does not mean that it is a satisfactory approach to the entire past of the human races.

This does not mean that our students are not to have the knowledge of oriental and other civilizations which they evidently need. But what they need to know about these areas they should be able to get outside the history course. What is really desired is information concerning the present condition of these peoples, and this can be better obtained through the study of sociology, anthropology, economics, and related fields. This is properly the domain of the social sciences, and they are capable of providing what little historical background is necessary. We should remember, too, that the historian is rare who is competent to deal with these areas satisfactorily; certainly very few people are really familiar with the past of more than one exotic culture. It would indeed be of value for the student to take a course in the history of each of these civilizations, but we know that the time

in the curriculum does not permit it. What we need is something like the area studies developed for the War Department in the Army Specialized Training Programs during the last war. Where these programs were well administered and the instructional personnel adequate, they were very effective, and it should not be impossible for the colleges, now relieved of the pressure of great emergency, to develop still better plans of this kind.

World history, as here defined, has several defects which make it unsuitable as a required course for undergraduates in the general education curriculum. Some of its objectives are achieved equally well by other disciplines, so that they do not in themselves justify this organization. It does not afford the intelligible and logical unity of subject matter which the student has the right to expect, and which is of particular importance in history. And instructional materials are too often unsatisfactory by reason either of their inaccuracy or of their intricate and confusing organization.

In planning a course in occidental history, however, we are accomplishing the principal objective of all history training at this level: the increase of self-knowledge and self-understanding of the students, themselves products of the occidental past. We have also a manageable unity of study, one which all can learn to understand and grasp with the mind. We should strive for the greatest possible temporal extension of the course and should mention, if time permits, the origin of civilization in the Near East, with brief sketches of its earliest development. Treatment of Greek and Roman history is desirable, where the time allows it. In any case, we should begin at least in the fourth century A.D., with cumulative emphasis on later times. For the medieval period, the treatment can be oriented toward social and economic history, with relatively less emphasis on the details of politics. From the sixteenth century onward, we are dealing with the modern state system, and political developments demand greater attention. This is permitted by the greater amount of time allotted.

Throughout the course, original sources of every kind may be used to provide illustrations of abstract concepts (Cellini's *Autobiography* for "Renaissance man") or to acquaint the student with particular documents which have especial significance in our past (the Magna Carta, the Ninety-five Theses, the Declaration of the Rights of Man). Close study of these makes them more meaningful and interesting and teaches some of the historian's technique to the novice.

As we approach the present, we can broaden the scope of our course until, in the nineteenth century, occidental history may be seen as a true part of a larger whole, where it was in the past a more autonomous (not isolated) development of certain particular peoples. This seems to represent historical reality more faithfully than does the assertion that, because all mankind is now bound together intimately in a common fate, it has always been interdependent to the same degree. This very contrast between earlier relative self-sufficiency and present close interrelationship is one of the most significant facts to be presented. We cannot present it by pretending that the relationship has always been equally close.

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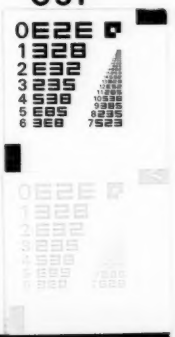
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